



U.S. Fish & Wildlife Service

John Heinz National Wildlife Refuge at Tinicum

*Comprehensive Conservation Plan
August 2012*



Front cover:

*Little horseshoe at John Heinz
National Wildlife Refuge at Tinicum*
Larry Woodward/USFWS

Interns
USFWS

Skyline
Derik Pinsonneault/USFWS

Earth Day hike
Kyle Gronostajski

Back cover:

*Little horseshoe at John Heinz
National Wildlife Refuge at Tinicum*
Larry Woodward/USFWS



*This blue goose, designed by
J.N. "Ding" Darling, has become
the symbol of the National Wildlife
Refuge System.*

The U.S. Fish and Wildlife Service (Service) is the principal Federal agency responsible for conserving, protecting, and enhancing fish, wildlife, plants, and their habitats for the continuing benefit of the American people. The Service manages the National Wildlife Refuge System comprised of over 150 million acres including 555 national wildlife refuges and thousands of waterfowl production areas. The Service also operates 70 national fish hatcheries and 81 ecological services field stations. The agency enforces Federal wildlife laws, manages migratory bird populations, restores nationally significant fisheries, conserves and restores wildlife habitat such as wetlands, administers the Endangered Species Act, and helps foreign governments with their conservation efforts. It also oversees the Federal Assistance Program which distributes hundreds of millions of dollars in excise taxes on fishing and hunting equipment to state wildlife agencies.



U.S. Fish & Wildlife Service

John Heinz National Wildlife Refuge at Tinicum

Comprehensive Conservation Plan *August 2012*

Submitted by:

Gary Stolz
Refuge Manager
John Heinz National Wildlife Refuge at Tinicum

7/17/2012

Date

Concurrence by:

Susan McMahon
Deputy Regional Chief, Region 5
National Wildlife Refuge System

7/31/12

Date

Scott Kahan
Regional Chief, Region 5
National Wildlife Refuge System

8/17/2012

Date

Approved by:

Acting
Wendi Weber
Regional Director, Region 5
U.S. Fish and Wildlife Service

22 Aug 2012

Date



U.S. Fish & Wildlife Service

John Heinz National Wildlife Refuge at Tinicum

Comprehensive Conservation Plan

August 2012

John Heinz National Wildlife Refuge at Tinicum Vision Statement

John Heinz National Wildlife Refuge at Tinicum is a green respite nestled within the urban setting of the city of Philadelphia. Refuge lands are a thriving sanctuary teeming with a rich diversity of fish, wildlife, and plants native to the Delaware Estuary. Healthy and productive expanses of freshwater tidal marsh, open waters, mudflats, and forests support the hundreds of species that breed, rear their young, rest during migration, and call the refuge home year-round.

With partners' support, the refuge leads by example in the restoration and conservation of freshwater tidal marsh within the Delaware Estuary. Also, given its accessibility and visibility to over 35 million Americans living within a 2-hour drive, the refuge serves as a prominent ambassador of the National Wildlife Refuge System. Its high quality programs promote natural and cultural resource stewardship, demonstrate the conservation of urban wildlife habitat, encourage compatible outdoor public use, and serve as a living classroom to connect people with nature and local history. Those who visit John Heinz NWR are inspired to take action to improve the quality of life for themselves and those around them.



U.S. Fish & Wildlife Service

John Heinz National Wildlife Refuge at Tinicum

Comprehensive Conservation Plan August 2012

Summary

Type of Action: Administrative—Development of a Comprehensive Conservation Plan

Lead Agency: U.S. Department of the Interior, U.S. Fish and Wildlife Service

Location: John Heinz National Wildlife Refuge at Tinicum
Philadelphia, PA

Administrative Headquarters: John Heinz National Wildlife Refuge at Tinicum
Philadelphia, PA

Responsible Official: Wendi Weber, Regional Director, Northeast Region

For Further Information: Lia McLaughlin, Natural Resource Planner
U.S. Fish and Wildlife Service
300 Westgate Center Drive
Hadley, MA 01035-9587
Phone: (413) 253-8575
Email: Lia_McLaughlin@fws.gov

This Comprehensive Conservation Plan for the 993-acre John Heinz National Wildlife Refuge is the culmination of a planning effort involving the U.S. Fish and Wildlife Service, Pennsylvania State agencies, local partners, refuge neighbors, private landowners, the Friends of Heinz Refuge, and the local community. This CCP establishes 15-year management goals and objectives for the refuges' wildlife and habitats, public use programs, and administration and facilities.

This plan sets forward the management direction that we think best achieves the refuge's purposes, vision, and goals, and responds to public issues. Under this plan, we will focus on increased restoration of freshwater tidal marsh and providing environmental education programs for urban youth. We will also increase efforts to monitor for the effects of climate change.

Chapters

Chapter 1 The Purpose of, and Need for, Action

1.1 Introduction to John Heinz National Wildlife Refuge	1-1
1.2 Purpose of, and Need for, the Proposed Action	1-2
1.3 Service and Refuge System: Policies and Mandates Guiding Planning	1-7
1.4 Refuge Establishing Purposes	1-12
1.5 Conservation Plans and Initiatives Guiding the Proposed Action	1-12
1.6 Refuge Vision	1-16
1.7 Refuge Goals	1-16

Chapter 2 The Comprehensive Conservation Planning Process

2.1 Introduction	2-1
2.2 Steps in the Planning Process	2-1
2.3 Issues, Concerns, and Opportunities	2-3

Chapter 3 Existing Environment

3.1 Introduction	3-1
3.2 The Physical Landscape	3-1
3.3 The Cultural Landscape Setting and Land Use History	3-2
3.4 The Current Climate and Potential Effects of Climate Change	3-5
3.5 Air Quality	3-10
3.6 Soils	3-11
3.7 Hydrology and Water Quality	3-11
3.8 Noise and Soundscapes	3-14
3.9 Socioeconomic Landscape	3-15
3.10 Refuge Administration	3-17
3.11 Refuge Natural Resources	3-18
3.12 Refuge Biological Resources	3-19
3.13 Special Use Permits, Including Research	3-36
3.14 Refuge Visitor Services Program	3-37
3.15 Archaeological and Historical Resources	3-40

Chapter 4 Management Direction and Implementation

4.1 Introduction	4-1
4.2 General Refuge Management	4-2
4.3 Conducting Additional NEPA Analysis	4-14
4.4 Refuge Goals, Objectives, and Strategies	4-14

Chapter 5 Consultation and Coordination

5.1 Introduction	5-1
5.2 Planning to Protect Land and Resources	5-1
5.3 Partners Involved in Refuge Planning	5-4
5.4 Contact Information	5-8

Chapter 6 List of Preparers

6.1 Members of the Core Planning Team	6-1
6.2 Assistance from Other Service Personnel	6-1

Chapters (cont.)

Bibliography

Bibliography	Bibl-1
------------------------	--------

Glossary and Acronyms

Glossary	Glos-1
Acronyms	Glos-12

Appendixes

Appendix A Known Species of Conservation Concern

Known Species of Conservation Concern	A-1
---	-----

Appendix B Findings of Appropriateness and Compatibility Determinations

Finding of Appropriateness—Dog Walking in Designated Areas	B-1
Compatibility Determination—Dog Walking in Designated Areas	B-3
Finding of Appropriateness—Jogging	B-9
Compatibility Determination—Jogging	B-11
Finding of Appropriateness—Non-motorized Boating	B-19
Compatibility Determination—Non-motorized Boating	B-21
Finding of Appropriateness—Bicycling	B-27
Compatibility Determination—Bicycling	B-29
Compatibility Determination—Recreational Fishing	B-35
Compatibility Determination—Wildlife Observation, Photography, Environmental Education, and Interpretation.	B-43

Appendix C Final Habitat Management Plan

Final Habitat Management Plan	C-1
---	-----

Appendix D Refuge Staffing Charts

Current Staffing	D-1
Proposed Staffing	D-2

Appendix E Refuge Operating Needs System (RONS) and Service Asset Maintenance Management System (SAMMS)

Budget and Refuge Operations Needs System (RONS) Projects for John Heinz National Wildlife Refuge at Tinicum	E-1
Service Asset Maintenance Management Systems (SAMMS) Projects for John Heinz National Wildlife Refuge at Tinicum	E-2

Appendix F Wilderness Review

F.1 Introduction	F-1
F.2 Minimum Wilderness Criteria	F-1
F.3 Inventory Conclusions	F-2
F.4 Service Summary and Conclusion of Wilderness Inventory Findings	F-2

Appendix G Wild and Scenic Rivers Review

G.1 Introduction	G-1
G.2 Wild and Scenic River Review	G-1
G.3 Service Summary and Conclusion of Wild and Scenic River Review	G-1

Appendixes (cont.)

Appendix H USGS Phase I Environmental Education Report

USGS Phase I Environmental Education Report	H-1
---	-----

Appendix I Sea Level Affecting Marshes Model (SLAMM) Report

Sea Level Affecting Marshes Model (SLAMM) Report	I-1
--	-----

Appendix J Facility Design Plan

Facility Design Plan	J-1
--------------------------------	-----

Appendix K Summary of Public Comments and Service Responses on the Draft Comprehensive Conservation Plan and Environmental Assessment for John Heinz National Wildlife Refuge at Tinicum

Introduction	K-1
Summary of Comments Received	K-1
Service Responses to Comments by Subject	K-2

Appendix L Finding of No Significant Impact

Finding of No Significant Impact (FONSI)	L-1
--	-----

List of Figures

Figure 2.1	The Comprehensive Conservation Planning Process	2-1
Figure 3.1	Aerial photograph of John Heinz NWR lands in 1928 (prior to refuge establishment).	3-4
Figure 3.2	Monitored Sea Levels at Philadelphia, Pennsylvania (1900 to 2000)	3-6
Figure 3.3	Shorebird, Waterfowl, and Wader Abundance (adjusted for partial observability) and Water Gauge Levels within the 145-acre impoundment at John Heinz NWR	3-25
Figure C.1	Historic Maps of Philadelphia Region	C-19
Figure C.2	Aerial photograph of John Heinz NWR lands in 1928 (prior to refuge establishment).	C-20
Figure C.3	Monitored sea levels at Philadelphia (1900–2000) displaying nearly a 1-foot rise in sea level over the past century	C-22
Figure C.4	Shorebird, waterfowl, and wader abundance (adjusted for partial observability) and water gauge levels within the 145-acre impoundment at John Heinz NWR	C-61
Figure H.1	Map of John Heinz NWR.	H-7
Figure H.2	John Heinz NWR in reference to Philadelphia as the center of the Pennsylvania Greater Metropolitan Area.	H-8
Figure H.3	Planning Context for Stakeholder Assessment Project.	H-9
Figure H.4	Current John Heinz NWR Staffing.	H-10
Figure I.1	Summary of SLR scenarios utilized.	I-7
Figure I.2	Contours at 0 feet through 6 feet over DEM of John Heinz NWR.	I-8
Figure I.3	Current impoundments and removed impoundments at Henderson and Corps property.	I-9
Figure I.4	Input sub-sites.	I-9
Figure I.5	NOAA Gage Relevant to the Study Area	I-10
Figure I.6	Satellite image of central portion of John Heinz NWR.	I-17

List of Tables

Table 3.1	Predicted Net Loss of Habitat Types at John Heinz NWR Using a Simulated Scenario of a 2.3 feet of Sea Level Rise through 2100. . . .	3-9
Table 3.2	Land Acquisition History of John Heinz NWR.	3-17
Table 3.3	Broad Habitat Types and National Vegetation Classification System Associations and Alliances Found within John Heinz NWR	3-22
Table 3.4	Summary of Existing Open Water Features at John Heinz NWR	3-24
Table 3.5	Bird Groups and Optimal Conditions for Migratory Stopover and Forage Enhancement Within the Impoundment	3-26
Table 3.6	Fish Species and Use of Lower Darby Creek and Freshwater Tidal Marsh Habitats	3-33
Table 3.7	Invasive Species Identified at John Heinz NWR and Their Associated Management Ranking	3-35
Table 3.8	Number of Refuge Participants by Activity (2009)	3-37
Table C.1	Broad Habitat Types and National Vegetation Classification System Associations and Alliances Found Within John Heinz NWR Based on the National Vegetation Classification System.	C-28
Table C.2	Fish Species and Utilization of Lower Darby Creek and Freshwater Tidal Marsh Habitats	C-33
Table C.3	Invasive Species Identified at John Heinz NWR and Their Associated Management Ranking.	C-35
Table C.4	Summary of Habitats that Represent Existing BIDEH for John Heinz NWR.	C-41
Table C.5	Priority Resources of Concern and Associated Focal Species for John Heinz NWR.	C-45
Table C.6	Focal Species, Associated Habitat Requirements, and Other Species Benefitting from Habitat Management at John Heinz NWR	C-47
Table C.7	Priority Habitats and Their Potential Limiting Factors at John Heinz NWR.	C-50
Table C.8	Bird Groups and Optimal Conditions for Migratory Stopover and Forage Enhancement within the Impoundment.	C-60
Table C.9	Management Units at John Heinz NWR	C-68
Table E.1	Refuge Operations and Needs System (RONS) table.	E-1
Table E.2	Service Asset Maintenance Management Systems (SAMMS) table . .	E-2
Table H.1	Delaware Valley Counties.	H-6
Table H.2	Annual Number of Visitors to the John Heinz NWR	H-12
Table H.3	Annual Visitation by Other Types of Effort at the John Heinz NWR . .	H-12
Table H.4	Refuge Programming	H-13
Table H.5	Onsite Events and Festivals.	H-14
Table H.6	Onsite Programs—Facilitated Learning Experiences.	H-15
Table H.7	Onsite Training for Teachers and Pre-service Teachers.	H-17

List of Tables (cont.)

Table H.8	Onsite Research	H-18
Table H.9	Onsite Meetings and Retreats	H-18
Table H.10	Offsite Events or Festivals in which John Heinz NWR Participates . . .	H-18
Table H.11	Offsite Presentations or Programs Presented by John Heinz NWR Staff.	H-18
Table H.12	Potential Environmental Education Partners for John Heinz NWR. . .	H-20
Table H.13	Summary of Select Refuge Outreach Printed Material.	H-22

List of Maps

Map 1.1	John Heinz NWR and Regional Context within the Delaware Estuary .	1-4
Map 1.2	John Heinz NWR Location and Relation to Regional Conservation Lands	1-5
Map 1.3	John Heinz NWR Ownership Status	1-6
Map 3.1	Habitats of John Heinz NWR	3-20
Map 3.2	Plant Communities of John Heinz NWR.	3-21
Map 3.3	Current Visitor Service Facilities at John Heinz NWR	3-38
Map 4.1	Proposed Habitats Comprising John Heinz NWR	4-16
Map 4.2	Proposed Visitor Services Facilities at John Heinz NWR	4-17
Map B.1	Access roads where dog walking is allowed at John Heinz NWR. . . .	B-8
Map B.2	Visitor facilities at John Heinz NWR	B-17
Map B.3	Visitor Facilities at John Heinz NWR.	B-25
Map B.4	Access roads and trails where bicycling is authorized on John Heinz NWR	B-34
Map B.5	Visitor facilities at John Heinz NWR	B-41
Map B.6	Visitor facilities at John Heinz NWR	B-50

Chapter 1

Ron Holmes/USFWS



A bald eagle soars over the refuge with a fish.

The Purpose of, and Need for, Action

- 1.1 Introduction to John Heinz National Wildlife Refuge
- 1.2 Purpose of, and Need for, the Proposed Action
- 1.3 Service and Refuge System: Policies and Mandates Guiding Planning
- 1.4 Refuge Establishing Purposes
- 1.5 Conservation Plans and Initiatives Guiding the Proposed Action
- 1.6 Refuge Vision
- 1.7 Refuge Goals

1.1 Introduction to John Heinz National Wildlife Refuge

John Heinz National Wildlife Refuge at Tinicum (NWR, refuge) currently includes 993 acres of the 1,200 acres within its approved acquisition boundary. The refuge protects over 200 acres of the last remaining freshwater tidal marsh in Pennsylvania. It is an important migratory stopover along the Atlantic Flyway, and provides protected breeding habitat for State-listed threatened and endangered species, as well as many neotropical migratory birds (Cohen 2004). The refuge is located in Philadelphia and Delaware Counties in the Commonwealth of Pennsylvania (map 1.1)

John Heinz NWR includes a variety of important resources and also provides a unique opportunity for education and outreach near the urban center of the city of Philadelphia, the nation's fifth largest metropolitan area (U.S. Census Bureau 2011). Sustaining and protecting these resources requires planning, active on-the-ground management, and partnerships with the surrounding communities of the Delaware Valley.

John Heinz NWR is managed by the United States Fish and Wildlife Service (USFWS, the Service, our, we) as part of the National Wildlife Refuge System (Refuge System). The Refuge System maintains the biological integrity, diversity, and environmental health of natural resources on lands within it for the benefit of present and future generations.

We prepared this Comprehensive Conservation Plan (CCP) for the refuge as required by the National Wildlife Refuge System Administration Act of 1996, as amended by the National Wildlife Refuge System Improvement Act of 1997 (P.L. 105-57; 111 Stat. 1253) (Refuge Improvement Act). An environmental assessment (EA), required by the National Environmental Policy Act (NEPA) of 1969, as amended (42 U.S.C. 4321 *et seq.*, 83 Stat. 852) was prepared concurrent with the draft CCP. The decision to adopt this plan and its "Finding of No Significant Impact" are included as appendix L.

This document presents the combination of management goals, objectives, and strategies that will guide the management decisions and actions of John Heinz NWR over the next 15 years. It also helps Pennsylvania natural resource agencies, our conservation partners, local communities, and the public understand our priorities and work with us to achieve common goals.

This CCP is organized in six chapters to outline the history, driving mandates, purposes, and conservation priorities guiding the management direction, as well as the existing environment of the refuge.

Chapter 1, "The Purpose of, and Need for, Action," explains the purpose of, and need for, preparing a CCP and EA, and introduces the five subsequent chapters and twelve appendixes.

Chapter 2, "The Planning Process," describes our planning process, including public and partner involvement, its compliance with NEPA regulations, and identifies public issues or concerns that surfaced during plan development.

Chapter 3, "Existing Environment," describes the biological and socioeconomic landscape context as well as the physical, biological, and human environments of the refuge.

Chapter 4, "Management Direction and Implementation," presents the actions, goals, objectives, and strategies that will guide our decision-making and land management for the refuge. It also outlines the staffing and funding needed to accomplish that management.

1.2 Purpose of, and Need for, the Proposed Action

Chapter 5, “Consultation and Coordination with Others,” summarizes how the Service involved the public and our partners in the planning process. Their involvement is vital for the future management of this refuge and all national wildlife refuges.

Chapter 6, “List of Preparers,” credits Service and non-Service contributors to the planning effort.

Eleven appendixes, a glossary with acronyms, and a bibliography section provide additional documentation and references to support our analysis summarized within the report.

In 1997, Congress passed the Refuge Improvement Act establishing a unifying mission for the Refuge System. The Refuge Improvement Act highlights six priority public uses that each refuge should evaluate for compatibility with its “wildlife-first” mandate. These six public uses include wildlife observation, interpretation, photography, environmental education, hunting, and fishing. The Refuge Improvement Act also requires that all refuges established prior to 1997 prepare a CCP by 2012.

The Service proposes to develop a CCP for the refuge that, in the Service’s best professional judgment, best achieves the purposes, vision, and goals of the refuge; contributes to the mission of the Refuge System; adheres to Service policies and other mandates; addresses identified issues of significance; and incorporates sound principles of fish and wildlife science.

The purpose of adopting a CCP for this refuge is to accomplish the following goals:

- Goal 1.** Protect, maintain, and restore, where possible, the biological integrity, diversity, and environmental health of southeastern Pennsylvania coastal plain ecological communities that are unique to the refuge and sustain native plants and wildlife, including species of conservation concern.
- Goal 2.** Contribute to the enhancement of native species diversity in the Delaware Estuary, including migratory birds and other species of conservation concern, within the refuge’s managed open waters and grasslands.
- Goal 3.** Provide a wide range of environmental educational opportunities, focusing on urban youth, which raise awareness and understanding of the Service and the National Wildlife Refuge System, inspire appreciation and stewardship of our natural and cultural resources, and expand understanding of Tinicum Marsh as a unique component of the Delaware Estuary and the local community.
- Goal 4.** Ensure that visitors, students, and local residents of all ages and abilities enjoy their refuge experience, understand and appreciate the refuge’s natural and cultural resources and its contribution to conserving those resources in the Delaware Estuary, and are inspired to become better stewards in their everyday lives.
- Goal 5.** Provide quality, wildlife-dependent recreation that allows a diversity of visitors to connect with nature in the outdoors.
- Goal 6.** Communicate and collaborate with local communities, Federal and State agencies, Tribal governments, academic institutions, and conservation organizations throughout the Delaware Estuary to promote natural and cultural resource conservation and the mission of the National Wildlife Refuge System.

Several Service policies providing specific guidance on implementing the Refuge Improvement Act have been developed since the refuge was established. A CCP incorporates those policies, and develops strategic management direction for the refuge for 15 years that:

- States clearly the desired future conditions for refuge habitat, wildlife, visitor services, staffing, and facilities.
- Explains concisely to state agencies, refuge neighbors, visitors, partners, and other stakeholders the reasons for management actions.
- Ensures that refuge management conforms to the policies and goals of the Refuge System and legal mandates.
- Ensures that present and future public uses are appropriate and compatible.
- Provides long-term continuity and consistency in management direction.
- Justifies budget requests for staffing, operating, and maintenance funds.

In addition to the needs for a CCP outlined by Service policies and mandates, John Heinz NWR has not completed a large-scale planning effort since development of its original master plan in 1980. The refuge, its use, and the surrounding landscapes have changed significantly since that time. Additional property has been acquired, biological management has shifted from a preservation-based approach to adaptive management focus, and improvements have been made to promote refuge visitation and recreational use. Conservation science has also improved over the past 30 years, including identification of priority species for conservation in light of population trends, available habitat, and landscape-level biological threats. All these changes since the refuge master plan was developed were considered in development of this CCP.

Project Area

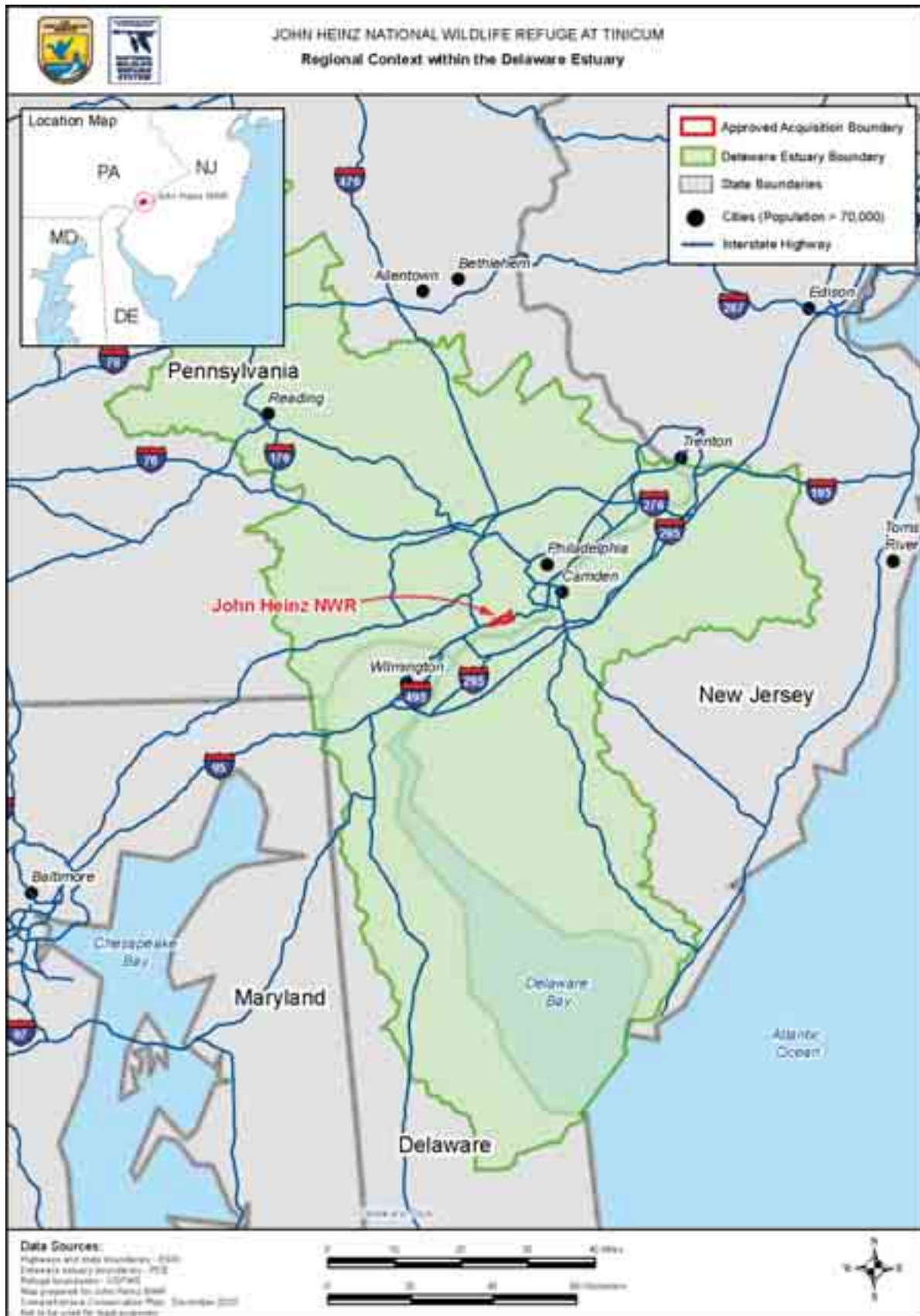
The project location is John Heinz NWR, which is located in Philadelphia and Delaware Counties in the State of Pennsylvania. Darby Creek flows through the site shortly before its confluence with the Delaware River. The regional context of the project area is defined by the interactions of the surrounding Philadelphia metropolitan area, the Delaware Estuary, and the Darby Creek watershed (see maps 1.1 through 1.3). The refuge lies within the Atlantic Coastal Plain physiographic province. This area is located in the most southeastern part of the State, running approximately 40 miles in length and 4 miles in width. Local relief is very low in this section and elevations range from sea level to 200 feet above sea level (PADCNR 2010a).



Mourning doves in Tinicum marsh

Larry Woodward/USFWS

Map 1.1. John Heinz NWR and Regional Context within the Delaware Estuary



Map 1.2. John Heinz NWR Location and Relation to Regional Conservation Lands



Map 1.3. John Heinz NWR Ownership Status



1.3 Service and Refuge System: Policies and Mandates Guiding Planning

The United States Fish and Wildlife Service and its Mission

As part of the Department of the Interior, the Service administers the Refuge System. The Service mission is, “Working with others to conserve, protect, and enhance fish, wildlife, and plants and their habitats for the continuing benefit of the American people.”

Congress entrusts to the Service the conservation and protection of the following national natural resources:

- Migratory birds and fish
- Federally listed, endangered or threatened species
- Interjurisdictional fish
- Wetlands
- Certain marine mammals
- National wildlife refuges

The Service also enforces Federal wildlife laws and international treaties on importing and exporting wildlife, assists states with their fish and wildlife programs, and helps other countries develop conservation programs.

The Service Manual (USFWS 2010) contains the standing and continuing directives on implementing our authorities, responsibilities, and activities. The Service publishes special directives that affect the rights of citizens or the authorities of other agencies separately in the Code of Federal Regulations (CFR); the Service Manual does not duplicate them (see 50 CFR 1–99 at: <http://www.gpoaccess.gov/cfr/index.html>; accessed January 2012).

The National Wildlife Refuge System and its Mission and Policies

The Refuge System is the world’s largest network of lands and waters set aside specifically for the conservation of wildlife and the protection of ecosystems. More than 550 national wildlife refuges encompass more than 150 million acres of lands and waters in all 50 states and several island territories. Each year, more than 40 million visitors hunt, fish, observe and photograph wildlife, or participate in environmental education and interpretation on refuges (Carver and Caudell 2007).

In 1997, President Clinton signed into law the National Wildlife Refuge System Improvement Act (Public Law 105-57; 111 Stat. 1253) amending the Refuge Administration Act (see Introduction of this chapter). The Refuge Improvement Act establishes the following unifying mission for the Refuge System:

“The mission of the System is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans” (Refuge Improvement Act; Public Law 105–57).

It also establishes a new process for determining compatibility of public uses on refuges, and requires the Service to prepare a CCP for each refuge. The Refuge Improvement Act states that the Refuge System must focus on wildlife conservation and that the mission of the Refuge System, coupled with the purpose(s) for which each refuge was established, will provide the principal management direction on that refuge.

The Refuge Manual contains policy governing the operation and management of the Refuge System that the Service Manual does not cover, including technical information on implementing refuge policies and guidelines on enforcing laws. The Service is in the process of updating and transferring the policies and

guidance in the Refuge Manual into the Service Manual. While many of these policies are in the Service Manual, some have not been transferred yet and are still recorded in the Refuge Manual (USFWS 1989). The Refuge Manual is not available online, but can be viewed at refuge headquarters. Following are a few noteworthy policies instrumental in developing this CCP.

Policy on the National Wildlife Refuge System Mission, Goals, and Purposes

This policy (601 FW 1) sets forth the Refuge System mission noted above, how it relates to the Service mission, and explains the relationship of the Refuge System mission and goals, and the purpose(s) of each unit in the Refuge System. In addition, it identifies the following Refuge System goals:

- Conserve a diversity of fish, wildlife, and plants.
- Develop and maintain a network of habitats.
- Conserve those ecosystems, plant communities, and wetlands that are unique within the United States (U.S.).
- Provide and enhance opportunities to participate in compatible, wildlife-dependent recreation.
- Help to foster public understanding and appreciation of the diversity of fish, wildlife, and plants and their habitats.

This policy also establishes the following management priorities for the Refuge System:

- Conserve fish, wildlife, and plants and their habitats.
- Facilitate compatible wildlife-dependent recreational uses.
- Consider other appropriate and compatible uses.

Policy on Refuge System Planning

This policy (602 FW 1, 2, 3) establishes the requirements and guidance for Refuge System planning, including CCPs and step-down management plans. It states that the Service will manage all refuges in accordance with an approved CCP that, when implemented, will help:

- Achieve refuge purposes.
- Fulfill the Refuge System mission.
- Maintain and, where appropriate, restore the ecological integrity of each refuge and the Refuge System.
- Achieve the goals of the National Wilderness Preservation System and the National Wild and Scenic Rivers System.
- Conform to other applicable laws, mandates, and policies.

This planning policy provides step-by-step directions and identifies the minimum requirements for developing all CCPs.

Policy on the Appropriateness of Refuge Uses

Federal law and Service policy provide the direction and planning framework for protecting the Refuge System from inappropriate, incompatible or harmful human activities and ensuring that visitors can enjoy its lands and waters. This policy (603 FW 1) provides a national framework for determining appropriate refuge uses to prevent or eliminate those that should not occur in the Refuge System. It describes the initial decision process the refuge manager follows when

first considering whether to allow a proposed use on a refuge. An appropriate use must meet at least one of the following four conditions:

- (1) The use is a wildlife-dependent recreational use as identified in the Refuge Improvement Act.
- (2) The use contributes to fulfilling the refuge purpose(s), the Refuge System mission, or goals or objectives described in a refuge management plan approved after October 9, 1997, the date the Refuge Improvement Act became law.
- (3) The use follows State regulations for the take of fish and wildlife.
- (4) The use has been found to be appropriate after concluding a specified findings process using 10 criteria.

We include the findings of appropriateness for John Heinz NWR in appendix B to this CCP.

Policy on Compatibility

This policy (603 FW 2) defines a compatible use as a use “that will not materially interfere with or detract from the fulfillment of the mission of the Refuge System or the purposes of the refuge.” The compatibility policy complements the appropriateness policy. Once a refuge manager finds a use appropriate, they conduct a further evaluation through a compatibility determination assessment. We include the compatibility determinations completed for those public uses determined to be appropriate for John Heinz NWR as appendix B to this CCP.

The policy provides guidelines for determining compatibility of uses and procedures for documentation and periodic review of existing uses. Highlights of this guidance follows:

- The Refuge Improvement Act and its regulations require an affirmative finding by the refuge manager on the compatibility of a public use before the Service allows it on a refuge.
- The refuge manager may authorize those priority uses on a refuge when they are compatible and consistent with public safety.
- There are six wildlife-dependent recreational uses that are to receive enhanced consideration on refuges: hunting, fishing, wildlife observation and photography, environmental education and interpretation.
- When the refuge manager publishes a compatibility determination, it will stipulate the required maximum reevaluation dates: 15 years for wildlife-dependent recreational uses and 10 years for other uses. However, the refuge manager may reevaluate the compatibility of a use at any time; for example, sooner than its mandatory date if new information reveals unacceptable impacts or incompatibility with refuge purposes (603 FW 2.11, 2.12).
- The refuge manager may allow or deny any use, even one that is compatible, based on other considerations such as public safety, policy, or available funding.

Policy on Wildlife-dependent Public Uses

This policy (605 FW 1) presents specific guidance on implementing management of the priority public uses. This policy defines a quality, wildlife-dependent recreational program as one that:

- (1) Promotes safety of participants, other visitors, and facilities.
- (2) Promotes compliance with applicable laws and regulations and responsible behavior.

- (3) Minimizes or eliminates conflict with fish and wildlife population or habitat goals or objectives in an approved plan.
- (4) Minimizes or eliminates conflicts with other compatible, wildlife-dependent recreational uses.
- (5) Minimizes conflicts with neighboring landowners.
- (6) Promotes accessibility and availability to a broad spectrum of the American people.
- (7) Promotes resource stewardship and conservation.
- (8) Promotes public understanding and increases public appreciation of America's natural resources and our role in managing and conserving these resources.
- (9) Provides reliable and reasonable opportunities to experience wildlife.
- (10) Uses facilities that are accessible to people and blend into the natural setting.
- (11) Uses visitor satisfaction to help define and evaluate programs.

**Policy on Maintaining
Biological Integrity,
Diversity, and
Environmental Health**

This policy (601 FW 3) provides guidance on maintaining and restoring the biological integrity, diversity, and environmental health of the Refuge System, including the protection of a broad spectrum of fish, wildlife, and habitat resources in refuge ecosystems. It provides refuge managers with a process for evaluating the best management direction to prevent the additional degradation of environmental conditions and restore lost or severely degraded components of the environment. It also provides guidelines for dealing with external threats to the biological integrity, diversity, and environmental health of a refuge and its ecosystem.

Other Mandates

Although Service and Refuge System policy and the purpose(s) of each refuge provide the foundation for its management, other Federal laws, executive orders, treaties, interstate compacts, and regulations on conserving and protecting natural and cultural resources also affect how the Service manages refuges. The "Digest of Federal Resource Laws of Interest to the U.S. Fish and Wildlife Service" describes many of them at: <http://www.fws.gov/laws/Lawsdigest.html> (accessed January 2012).

Of particular note are the Federal laws that require the Service to identify and preserve its important historic structures, archaeological sites, and artifacts. NEPA mandates our consideration of cultural resources in planning Federal actions. The Refuge Improvement Act requires the CCP for each refuge to identify its archaeological and cultural values. Following is a highlight of some cultural and historic resource protection laws which relate to the development of CCPs.

The Archaeological Resources Protection Act (16 U.S.C. 470aa–470ll; P.L. 96–95) approved October 31, 1979 (93 Stat. 721), largely supplanted the resource protection provisions of the Antiquities Act of 1906 for archaeological items. The Archaeological Resources Protection Act establishes detailed requirements for issuance of permits for any excavation or removal of archaeological resources from Federal or Native American lands. It also establishes civil and criminal penalties for the unauthorized excavation, removal, or damage of those resources; for any trafficking in those removed from Federal or Native American land in violation of any provision of Federal law; and for interstate and foreign commerce

in such resources acquired, transported, or received in violation of any state or local law.

The Archeological and Historic Preservation Act (16 U.S.C. 469–469c; P.L. 86–523,) approved June 27, 1960 (74 Stat. 220), as amended by P.L. 93–291, approved May 24, 1974 (88 Stat. 174), carries out the policy established by the Historic Sites, Buildings and Antiquities Act (see below). It directs Federal agencies to notify the Secretary of the Interior whenever they find that a Federal or federally assisted licensed or permitted project may cause the loss or destruction of significant scientific, prehistoric, or archaeological data. The act authorizes the use of appropriated, donated, or transferred funds for the recovery, protection, and preservation of that data.

The Historic Sites, Buildings and Antiquities Act (Historic Sites Act) (16 U.S.C. 461–462, 464–467; 49 Stat. 666) of August 21, 1935, as amended by P.L. 89–249, approved October 9, 1965 (79 Stat. 971), declares it a national policy to preserve historic sites and objects of national significance, including those located on refuges. It provides procedures for designating, acquiring, administering, and protecting them. Among other things, National Historic and Natural Landmarks are designated under the authority of this act.

The National Historic Preservation Act of 1966 (16 U.S.C. 470–470b, 470c–470n), P.L. 89–665, approved October 15, 1966 (80 Stat. 915), and repeatedly amended, provides for the preservation of significant historical features (buildings, objects, and sites) through a grant-in-aid program to the states. It establishes a National Register of Historic Places and a program of matching grants under the existing National Trust for Historic Preservation (16 U.S.C. 468–468d). This act establishes an Advisory Council on Historic Preservation, which became a permanent, independent agency under P.L. 94–422, approved September 28, 1976 (90 Stat. 1319). The act also created the Historic Preservation Fund. It directs Federal agencies to take into account the effects of their actions on items or sites listed or eligible for listing on the National Register of Historic Places.

The Service also has a mandate to care for museum properties it owns in the public trust. The most common are archaeological, zoological, and botanical collections, and historical photographs, objects, and art. Each refuge maintains an inventory of its museum property. Our museum property coordinator in Hadley, Massachusetts, guides the refuges in caring for that property, and helps us comply with the Native American Grave Protection and Repatriation Act (P.L. 101-601) and Federal regulations governing Federal archaeological collections. This program ensures that those collections will remain available to the public for learning and research.

Other Federal resource laws are also important to highlight as they are integral to developing a CCP. The Wilderness Act of 1964 (16 U.S.C. 1131–1136; P.L. 88–577) establishes the National Wilderness Preservation System that is composed of federally owned areas designated by Congress as wilderness areas. The act directs each agency administering designated wilderness to preserve the wilderness character of areas within the National Wilderness Preservation System, and to administer the National Wilderness Preservation System for the use and enjoyment of the American people in a way that will leave those areas unimpaired for future use and enjoyment as wilderness. The act also directs the Secretary of the Interior to review every roadless area of 5,000 acres or more and every roadless island (regardless of size) within the Refuge System and National Park System for inclusion in the National Wilderness Preservation System. Service planning policy requires that the Service evaluate the potential for wilderness on refuge lands, as appropriate, during the CCP planning process.

We include the Wilderness Review for John Heinz NWR as appendix F to the CCP.

The Wild and Scenic Rivers Act of 1968 (P.L. 90-542; 16 U.S.C. 1271 *et seq.*), as amended, selects certain rivers of the nation possessing remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values; preserves them in a free-flowing condition; and protects their local environments. Service planning policy requires that the Service evaluate the potential for wild and scenic rivers designation on refuge lands, as appropriate, during the CCP planning process. We include the Wild and Scenic Rivers Review for John Heinz NWR as appendix G to this CCP.

1.4 Refuge Establishing Purposes

John Heinz NWR was established in 1972, under special legislation, for the following purpose:

- “Preserving, restoring, and developing the natural area known as Tinicum Marsh....a wildlife interpretative center for the purpose of promoting environmental education, and to afford visitors an opportunity for the study of wildlife in its natural habitat.” (86 Stat. 891, dated June 30, 1972).

Some additional refuge lands were acquired under the following authorities:

- To be of “particular value in carrying out the national migratory bird management program.” 16 U.S.C. §667b (An Act Authorizing the Transfer of Certain Real Property for Wildlife).
- “Development, advancement, management, conservation, and protection of fish and wildlife resources...(16 U.S.C. §742f (a)(4))...for the benefit of the United States Fish and Wildlife Service, in performing its activities and services....” 16 U.S.C. §742f(b)(1) (Fish and Wildlife Act of 1956).
- “[F]or use as an inviolate sanctuary, or for any other management purpose, for migratory birds....” 16 U.S.C. §715d (Migratory Bird Conservation Act).

1.5 Conservation Plans and Initiatives Guiding the Proposed Action

Important guidance for habitat management and visitor service management at John Heinz NWR has already been provided by a series of refuge-specific, State, regional, and national plans and their priorities.

Regional and National Plans and Initiatives

Refuge System Visioning: Fulfilling the Promise, Conserving the Future

The 1999 report, “Fulfilling the Promise, The National Wildlife Refuge System: Visions for Wildlife, Habitat, People and Leadership” (USFWS 1999), was the culmination of a year-long process by teams of Service employees to create a Refuge System vision. This report was a result of the first-ever Refuge System Conference held in Keystone, Colorado, in October 1998. It was attended by every refuge manager in the country, other Service employees, and scores of conservation organizations. The report contains 42 recommendations organized under 3 vision statements relating to wildlife and habitat, people, and leadership. We have often looked to these recommendations while writing this CCP. For example, the 1999 report recommends forging new alliances through citizen and community partnerships, and strengthening partnerships with the business community. One of the goals in our CCP is devoted to the development of community partnerships, while several of our strategies focus on forging new partnerships or strengthening existing ones.

The Refuge System’s “Conserving the Future” conference was convened in July 2011 to renew and update the 1999 vision. It began with a draft vision document. Over the course of the conference, the Service collected both online and in-person

feedback which was used to revise and finalize the draft vision. The Service finalized the “Conserving the Future” vision document in October 2011 (USFWS 2011). The document has 20 recommendations, including one focusing on urban refuges. Currently, implementation teams are developing strategies to help us accomplish the vision. We will incorporate implementation strategies for this recommendation and the others, as appropriate, in our step-down plans and refuge programs.

North Atlantic Landscape Conservation Cooperative Operations Plan (USFWS 2009a)

The Service is developing a coordinated network of landscape conservation cooperatives across the U.S. to address major environmental and human-related factors that limit fish and wildlife populations at the broadest of scales, including developing adaptation strategies in response to climate change. John Heinz NWR is located in the North Atlantic Landscape Conservation Cooperative, which is currently using the principles of strategic habitat conservation to develop and communicate landscape-scale scientific information to shape conservation across the northeastern U.S. The North Atlantic Landscape Conservation Cooperative’s Operations Plan outlines the regional threats to conservation, priority species, and habitats, as well as active regional partnerships.

Mid-Atlantic Coast Bird Conservation Region Implementation Plan (USFWS 2008a)

The implementation plan for the Mid-Atlantic Coast Bird Conservation Region combines regional plans, assessments, and research completed over the past two decades to develop continental-based bird conservation efforts. John Heinz NWR is located within the narrow portion of the Mid-Atlantic Coastal Plain in southeastern Pennsylvania. As such, this coastal zone is unique to the State of Pennsylvania and thus, many of the priority species listed for Bird Conservation Region 30 are also species of concern listed within the Pennsylvania Wildlife Action Plan. These rankings and the recommendations of the inventory have been considered along with other local and regional conservation priorities.

A Natural Heritage Inventory of Philadelphia County, Pennsylvania (PNHP 2008)

The Philadelphia County Natural Heritage Inventory was compiled by the Pennsylvania Department of Conservation and Natural Resource’s (PADCNR) Natural Heritage Program and the Western Pennsylvania Conservancy. It provides information on the general locations of rare, threatened, and endangered species and the highest quality natural areas in the county, and identifies areas in need of restoration. The Natural Heritage Program also provides State conservation rankings for each species of conservation concern in Pennsylvania. These rankings and the recommendations of the inventory have been considered along with other local and regional conservation priorities.

Pennsylvania Wildlife Action Plan (PGC and PFBC 2008)

The Pennsylvania Wildlife Action plan was completed in 2005 and updated in 2008 by the Pennsylvania Game Commission (PGC) and Pennsylvania Fish and Boat Commission (PFBC) (PGC and PFBC 2008). While creating a strategic focus for State fish and wildlife management agencies, this plan attempts to provide a Statewide perspective on conservation by presenting geographic, species, and habitat priorities. Considering John Heinz NWR’s protection of habitats unique to the State of Pennsylvania, species of conservation priority were considered in development of the refuge’s resources of concern.

USFWS Migratory Bird Program Strategic Plan (USFWS 2004)

The Migratory Bird Program Strategic Plan provides direction for the Services’ migratory bird management over the next decade (2004 to 2014). The plan contains a vision and recommendations for the Refuge System’s place in

bird conservation. It defines strategies for the Service, including the Refuge System, to actively support bird conservation through monitoring, conservation, consultation, and recreation. The refuge's habitat management plan (HMP), to the extent practical, uses standard monitoring protocols, habitat assessment and management, and promotes nature-based recreation and education to forward the vision of the Migratory Bird Program Strategic Plan.

USFWS Birds of Conservation Concern (USFWS 2008b)

The USFWS Birds of Conservation Concern report identifies the migratory and non-migratory bird species (beyond those already designated as federally threatened or endangered) that represent the Service's highest conservation priorities and draws attention to species in need of conservation action. The plan's geographic scope includes the U.S., including the island territories in the Pacific Ocean and Caribbean. Bird species considered for inclusion on lists in this report include nongame birds, gamebirds without hunting seasons, subsistence-hunted nongame birds in Alaska, and Endangered Species Act candidate, proposed endangered or threatened, and recently delisted species. Assessment scores are based on several factors, including population trends, threats, distribution, abundance, and area importance.

Wildlife Habitat in Pennsylvania, Past, Present, and Future (Goodrich et al. 2001)

Today, the PADCNr ranks coastal plain habitats as "impaired." The coastal plain region of Pennsylvania includes some of the last remaining habitats for certain wetland species in the State. The 2001 PADCNr report *Wildlife Habitat in Pennsylvania, Past, Present, and Future*, recommends that, where possible, wetlands along the Delaware River should be restored. The plan recommends urban forest management to provide habitat for some tolerant forest wildlife. The reduction of runoff into streams and wetlands is also noted as a top priority, along with restoration of natural communities in undeveloped areas.

Bird Conservation Plan for the Mid-Atlantic Coastal Plain (Physiographic Area 44) (PIF 1999)

Partners in Flight is a partnership of government agencies, private organizations, academic researchers, and private industry throughout North America focused on coordinating voluntary bird conservation efforts to benefit species at risk and their habitats. Bird conservation regions have been developed to guide management on a regional scale. Version 1.0 of the Mid-Atlantic Coastal Plain Bird Conservation Region Plan was completed in 1999. John Heinz NWR is located within this physiographic province and thus is considering the conservation priorities of this plan along with other conservation plans.

Delaware Estuary Comprehensive Conservation Management Plan (DEP 1996)

The Delaware Estuary is faced with continuing threats from toxic substances, habitat loss and fragmentation, and human development. To help address these threats, the Delaware Estuary Program worked with many partners to develop the Comprehensive Conservation and Management Plan for the Delaware Estuary (DEP 1996). The comprehensive conservation and management plan is a comprehensive document describing the existing conditions of the Delaware Estuary and providing seven action plans (land management, water use management, habitat and living resources, toxics, education and involvement, and monitoring) and an implementation plan. While the Delaware Estuary Program has since merged with the Partnership for the Delaware Estuary, this reorganized entity is still active and is now responsible for addressing the various actions identified in the comprehensive conservation and management plan. We used this plan as a reference in developing habitat management and land protection planning objectives.

Refuge-specific Plans

We consulted a number of other refuge-specific plans in either their draft or final format to help guide decision-making. These plans will also be maintained and updated as necessary to maintain accordance with the recommendations of the CCP.

John Heinz National Wildlife Refuge at Tinicum Habitat Management Plan (Appendix C)

The refuge's HMP (appendix C) proposes a long-term vision and specific guidance on managing the habitats for the identified resources of concern at John Heinz NWR. The plan provides direction for the next 15 years. Subsequent reviews every 5 years and use of adaptive management will assess and modify management activities as research, monitoring, and priorities require. This plan will be finalized upon final approval of the CCP.

White-tailed Deer Management Plan for John Heinz National Wildlife Refuge at Tinicum (D'Angelo 2012)

Refuge staff consulted with U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service, Wildlife Services to study the refuge's deer population and its impacts on refuge habitats, wildlife, and humans. The purpose of the deer management plan is to institute a biologically sound program to efficiently manage the deer population within a sustainable and healthy balance within the habitat and objectives of the refuge. This plan was finalized in conjunction with the final CCP.

Visitor Service Review (VanBeusichem et al. 2009)

A Service-based review team assessed the public use issues, opportunities, and facilities available at John Heinz NWR in preparation of the refuge's comprehensive conservation planning process and to develop recommendations to improve the quality of the refuge's visitor services program. The visitor services review recommendations are used as a stepping-off point for visitor services planning. We used its recommendations to help develop goals, objectives, and strategies for refuge visitor services planning.

Restoration Management Plan for the Lower Darby Creek with Recommendations for the John Heinz National Wildlife Refuge at Tinicum (Salas et al. 2006)

This restoration management plan was developed in 2006 by Delaware Riverkeeper Network under a Delaware Estuary Grant awarded to the Friends of the Heinz Refuge and funded by the National Fish and Wildlife Foundation. The purpose of this plan was to initiate an ecological restoration approach to habitat management at the refuge. This plan identified historic disturbances to the site, the ecological communities existing at the refuge, and provided recommendations for the restoration of a more natural ecological composition, structure, and function to these communities. The extensive field and Geographic Information System (GIS) data, along with historic records and information compiled as part of this plan, were used heavily in the development of the HMP.

Pennsylvania Important Bird Area #73: Phase I Conservation Plan (Cohen and Johnson 2004)

John Heinz NWR was designated as an important bird area by the National Audubon Society because of its critical location within the Atlantic Flyway and its complex of unique habitats. This plan identifies habitat-based site boundaries, describes the birds and wildlife habitat which occur on the site with special reference to the species for which the site was selected as an important bird area, identifies conservation issues and threats to the site, and provides recommendations for conservation actions. Its conservation recommendations are being considered with those of other refuge and regional plans.

Step-down Plans

The Service Manual's refuge planning policy (602 FW 4) identifies more than 25 step-down management plans that may be completed for each refuge. Those plans provide the details necessary to "step-down" general goals and objectives to specific strategies and implementation schedules. Some require annual revisions, while others are revised every 5 to 10 years. Some require additional NEPA analysis, public involvement, and compatibility determinations before they can be implemented. The following is a list of step-down plans that have already been completed for John Heinz NWR. Step-down plans that are currently in draft form or that will be started after CCP finalization are listed in chapter 4, section 4.2.15.

- Annual habitat work plan (most recently completed 2010, updated annually).
- Wildlife disease surveillance and contingency plan (completed 2006).
- Fire management plan (most recently completed 2006, updated annually).
- Hurricane action plan (most recently completed 2010, updated annually).
- Environmental management plan (most recently completed 2003, updated annually).
- Safety plan (most recently completed 2010, updated annually).

1.6 Refuge Vision

The planning team developed the following vision statement to provide a guiding philosophy and sense of purpose in the CCP.

John Heinz National Wildlife Refuge at Tinicum is a green respite nestled within the urban setting of the city of Philadelphia. Refuge lands are a thriving sanctuary teeming with a rich diversity of fish, wildlife, and plants native to the Delaware Estuary. Healthy and productive expanses of freshwater tidal marsh, open waters, mudflats, and forests support the hundreds of species that breed, rear their young, rest during migration, and call the refuge home year-round.

With partners' support, the refuge leads by example in the restoration and conservation of freshwater tidal marsh within the Delaware Estuary. Also, given its accessibility and visibility to over 35 million Americans living within a 2-hour drive, the refuge serves as a prominent ambassador of the National Wildlife Refuge System. Its high-quality programs promote natural and cultural resource stewardship, demonstrate the conservation of urban wildlife habitat, encourage compatible outdoor public use, and serve as a living classroom to connect people with nature and local history. Those who visit John Heinz National Wildlife Refuge are inspired to take action to improve the quality of life for themselves and those around them.

1.7 Refuge Goals

As we introduced earlier in this chapter, the planning team developed six goals (see section 1.2) after considering the vision statement, the purposes for establishing the refuge, the missions of the Service and the Refuge System, and the mandates, plans, and conservation initiatives noted above. These goals are intentionally broad, descriptive statements of purpose. They highlight elements that we will emphasize in the refuge's future management.

Chapter 2

Larry Woodward/USFWS



Mudflats

The Comprehensive Conservation Planning Process

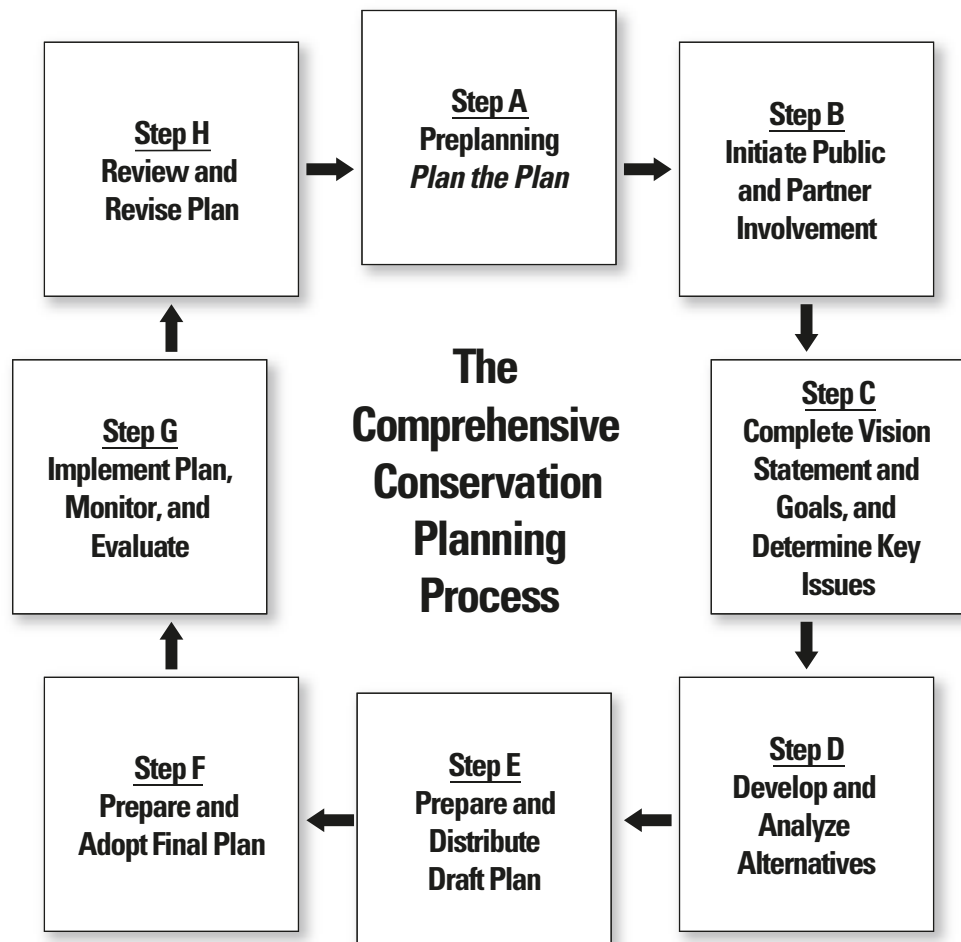
- 2.1 Introduction
- 2.2 Steps in the Planning Process
- 2.3 Issues, Concerns, and Opportunities

2.1 Introduction

Service policy (602 FW 3) establishes an eight-step planning process that also facilitates compliance with NEPA (see figure 2.1). The full text of the policy and a detailed description of the planning steps can be viewed at: <http://policy.fws.gov/602fw3.html> (accessed January 2012). The specific process implemented by John Heinz NWR's planning team in developing this CCP is described below.

Since 1972, we have focused on conserving lands within the approved refuge boundary; facilitating wildlife-dependent public uses; managing habitat for several focal species, such as waterfowl and waterbirds; and establishing relationships with the community and our partners.

Figure 2.1. The Comprehensive Conservation Planning Process



2.2 Steps in the Planning Process

Step A: Initial Planning

We began formally developing a CCP on January 21, 2010, during a conference call between refuge staff, Regional Office staff, and planning contractors. One of the major outcomes of the meeting was a timetable for accomplishing the major steps in the planning process. Initially, we focused on collecting information on the refuge's natural and cultural resources and public use program. The CCP core team of refuge and Regional Office staff and a representative from the

PGC started meeting to discuss existing information, draft a vision statement, and prepare for the public scoping meeting and a technical meeting of State and Federal partners.

Step B: Public Scoping

The process seeking public involvement officially began in early April 2010, when the planning team distributed a newsletter to approximately 377 individuals, organizations, and agencies announcing the planning process and public scoping period. A press release announcing the public scoping meeting and requesting public input was distributed to major media outlets on April 22, 2010. Next, the Notice of Intent to prepare a CCP was published in the *Federal Register* on Friday, May 7, 2010 (75 FR 25285).

Scoping activities in May 2010 included two public scoping meetings which were held at the visitor center on May 11, 2010. The meetings included a total of 24 attendees, including 17 attendees from the public and 7 members of refuge and planning staff. The meetings were held in an open house format with brief presentations on the refuge and CCP process status, followed by a question and answer session and informal discussion to identify issues and concerns. The planning team provided displays of the refuge context, habitat management units, visitor services and facilities, the past and planned marsh restoration projects, and handouts on the draft vision and goals.

The public scoping comment period ended on June 11, 2010. On June 21, 2010, the planning team discussed the major issues identified in the agency and public scoping meetings. A second newsletter was developed by the planning team to inform interested individuals, organizations, and agencies about the range of issues identified throughout the scoping process. The newsletter was sent to approximately 432 individuals, organizations, and agencies.

Steps C and D: Vision, Goals, and Alternatives Development

On February 19, 2010, invitations for the interagency scoping meeting were sent to 55 Federal and State contacts, elected officials, and 13 contacts from federally recognized Tribes associated with Pennsylvania, Delaware, and New Jersey. On March 29, 2010, the planning team met at the visitor center to finalize the draft vision and goals and coordinate agency scoping meeting logistics.

The agency scoping meeting was held on Wednesday, March 31, 2010, at the refuge's visitor center and included 26 attendees, including 13 contacts from partner agencies, 3 Service staff from Ecological Services, and 10 refuge and planning staff members. The meeting was held in a workshop-style format with brief presentations on the refuge and CCP process status; displays of the refuge context, habitat management units, visitor services, and facilities; and handouts on the draft vision and goals. We continued to consult with experts throughout 2010 and 2011, and to meet regularly as a core team, as we developed and refined our alternatives.

Step E: Draft CCP and NEPA Document

On March 22, 2012, we published a Notice of Availability in the *Federal Register* announcing our release of the draft CCP/EA for a 30-day period of public review and comment from March 22 to April 23. We distributed the draft CCP/EA to all interested parties, contacted the media, and posted it on our Web site during the comment period. We also hosted two public meetings in April 2012 at the refuge. We reviewed and summarized all comments received, wrote responses, and revised the CCP during May to August. Our response to public comments is in appendix K.

2.3 Issues, Concerns, and Opportunities

Step F: Adopt Final Plan

We submitted the final CCP to our Regional Director for approval in August 2012. The Regional Director determined that a Finding of No Significant Impact was warranted (see appendix L), and that our analysis was sufficient to simultaneously issue a decision adopting this CCP for the refuge. We announced the final decision by publishing a Notice of Availability in the *Federal Register*, where we also notified people of the availability of the final CCP. These actions complete planning step F to prepare and adopt a final plan.

Step G and H: Implement, Evaluate, and Revise the Plan

With the planning phase of the CCP process complete, “Step G: Implement Plan, Monitor and Evaluate” will begin. Periodic review of the CCP will be required to ensure that objectives are being met and management actions are being implemented. Ongoing monitoring and evaluation will be an important part of this process. Monitoring results or new information may indicate the need to change our strategies.

As part of “Step H: Review and Revise Plan,” the Service will modify or revise the final CCP, as warranted, following the procedures in Service policies 602 FW 1, 3, and 4 and the NEPA requirements. Minor revisions that meet the criteria for categorical exclusions (550 FW 3.3C) will require only an environmental action memorandum. As the Refuge Improvement Act and Service policy stipulate, the Service will review and revise the CCP at least every 15 years.

The Service defines an issue as “any unsettled matter requiring a management decision” (USFWS 2010). Issues can include an “initiative, opportunity, resource management problem, threat to a resource, conflict in use, or a public concern.” Issues arise from many sources, including refuge staff; other Service programs; other Federal, state, local, and Tribal agencies; Congress; or our partners, neighbors, and user groups. One of the distinctions among the proposed management alternatives is how each addresses those issues.

From agency and public meetings and planning team discussions, we developed a list of issues, concerns, opportunities, and other items requiring a management decision. We placed them in two categories: key issues and issues outside the scope of this analysis and the EA.

Key issues—Key issues are those the Service has the jurisdiction and authority to resolve. The key issues, together with refuge goals, formed the basis for developing the management direction we describe in chapter 4.

Issues and concerns outside the scope of this analysis—These topics fall outside the jurisdiction and authority of the Service or were deemed impractical. We discuss them after “Key Issues” below, but this plan does not address them further.

The following summary provides a context for the issues that arose during the scoping process.

Key Issues

We derived the following key issues from public and partner meetings and planning team discussions.

Biological Management

For national wildlife refuges, the conservation of wildlife and habitats is the highest priority, and serves as the foundation for all that the Service does. Many refuges were established for a very specific purpose, such as protecting a

particular species or habitat. John Heinz NWR has specific purposes mandating the preservation and restoration of Tinicum Marsh, as well as development of the refuge as an environmental education center.

Protection and restoration of coastal plain wetlands and their associated species on the refuge is an important issue addressed in the CCP. The planning team received many opinions on specific actions or techniques to accomplish that endeavor. Some suggestions and actions fall outside Service jurisdiction. Some are best accomplished in partnership with other Federal or State agencies, or non-governmental organizations.

Specific questions asked regarding the topic of biological management, include:

(1) How will the refuge accommodate potential impacts of climate change on existing refuge habitats?

Climate change and its corresponding effects on sea level rise, species migrations, extreme shifts in temperature and precipitation, historic species range distributions, and invasive species introductions may pose dramatic threats and alterations to the habitats encompassed within the refuge and the world. The ability to adapt to or address these ever-changing concerns requires a comprehensive understanding of the refuge's landscape context, individual habitats, species utilization, and their resilience.

John Heinz NWR is located at or near sea level and is subject to tidal hydrology across much of its lands. We are evaluating potential changes caused by rising sea levels. We have analyzed the effect of sea level rise on refuge habitats through the use of a Sea Level Affecting Marshes Model (SLAMM) analysis originally completed in 2009, and recently refined in December 2010. We include the SLAMM analysis as appendix I to this CCP. We also discuss the results of the analysis in chapter 3.

(2) How will the refuge work to improve its biological connectivity with other habitats throughout the region?

Fragmentation of both terrestrial and aquatic habitats can have adverse effects on many plant, fish, and wildlife species by reducing biodiversity, limiting genetic diversity, and increasing susceptibility to species invasion and other stressors.

The refuge is a biological oasis in an intensely urbanized landscape. As a result, except for a few rivers, streams, and riparian lands, few opportunities remain for improving biological connections to adjacent habitats. Most lands providing optimal connection to adjacent habitats are located outside refuge lands and require extensive landowner or partner coordination.

We envision working with a variety of partnerships with Federal, State, and non-governmental organizations to address biological connectivity to the refuge. We discuss how the refuge will respond to connectivity needs in chapter 4 under goals 1 and 2.

(3) How will the refuge continue to fulfill its original mandated purpose to protect Tinicum Marsh and conserve freshwater tidal marsh it encompasses?

Several questions and comments from State and Federal agencies focused on the refuge's protection of the original remnant of Tinicum Marsh, as well as expanding the freshwater tidal marsh through restoration of additional lands that were historically marsh.

Restoration of freshwater tidal marshes on other parts of the refuge through the removal of former fill material is a complex undertaking. Considerations of soil composition (including potential contaminants), surface elevations, hydrologic conditions, species establishment, and long-term maintenance are all necessary for successful restoration. Climate change impacts, such as sea level rise, increase the complexity for future tidal marsh restoration projects. These projects are also costly due to the equipment, duration, regulatory requirements, and complexities required in construction. Many areas of former tidal marsh have been altered and now encompass open water areas or forested habitats.

Identifying the ideal location and conditions for tidal marsh restoration, and evaluating their existing versus future potential in light of existing habitats and threats from climate change, will be necessary to ensure cost-effective and successful results. We discuss how the refuge will respond to concerns related to freshwater tidal marsh conservation and restoration needs in chapter 4 under goal 1.

(4) How will the refuge manage invasive, nonnative, and overabundant species?

Invasive plant species threaten refuge habitats by displacing native plant and animal species, degrading wetlands and other natural communities, and reducing natural diversity and wildlife habitat values.

Climate change may also result in a shift of species distributions or conditions across the region that may allow introduction of additional species in the future. Prioritization and management of invasive species should be put in context with other regional efforts to be most effective, but is compounded by limits on staff and resources available to implement treatments against invasive species.

Native species can also adversely affect natural biological diversity when they become overabundant. Numerous Federal and State agency partners noted the importance of managing and controlling both invasive, nonnative species and overabundant native species. Our response to these concerns is discussed in chapter 4 under goals 1 and 2.

(5) How will the refuge manage its 145-acre impoundment?

Impoundments are confined bodies of water. The refuge has one large impoundment with a water control structure totaling approximately 145 acres and two small impoundments without water control structures totaling approximately 20 acres. Natural changes in water levels can occur from rainfall and natural springs. Water levels in the impoundment with a water control structure can be altered by inserting or removing boards that either release water or allow tidal water to flow into the impoundment. Changes in water levels during specific times of the year provide habitat and food for an array of wildlife including shorebirds, wading birds, and waterfowl.

The 145-acre open water impoundment is the most accessible area for public observation of wildlife and a focal point for many refuge visitors. It provides a combination of habitats for migratory birds, and supplementary habitat for rare species of reptiles and amphibians. Water level management is difficult due to groundwater elevations, stormwater inputs, the staff resources required, and the capacity, design, and location of the control structures. Some recommendations have been made to restore part or all of the impoundment to freshwater tidal marsh as well as maintain it as open water, but with fluctuating (possibly tidal) hydrology. Our response to these concerns is discussed in chapter 4 under goals 1 and 2.

(6) How will the refuge address contaminants and other environmental hazards that may adversely affect wildlife and other resources on the refuge?

Polychlorinated biphenyls, polycyclic aromatic hydrocarbons, and other toxic hazards are known to occur within refuge lands and waters, posing a health risk to fish and wildlife species using the refuge. These compounds affect fish and wildlife by causing reproductive abnormalities, increasing embryonic mortality, increasing physical abnormalities, and decreasing immune system response.

The Lower Darby Creek Remedial Area is a designated Superfund site that consists of two closed landfills that pose these environmental health hazards to the refuge. The U.S. Environmental Protection Agency (USEPA), as a result of the Superfund designation, is leading the remediation efforts. One of these sites, Folcroft Landfill, is located on refuge property. This site is undergoing implementation of a long-term remediation strategy. Some concerns were voiced regarding the immediate and long-term effect of these compounds on fish and wildlife at the refuge. Our response to these concerns is discussed in chapter 4 under goals 1 and 2.

(7) What role will the refuge play in conservation throughout the Delaware Valley region?

The refuge, located within the City of Philadelphia and within an hour of four states (Pennsylvania, New Jersey, Delaware, and Maryland), has the potential to act as a regional portal for conservation. Its location and facilities can provide suitable accommodations for meetings, events, and other forums. Refuge staff has the potential to act as a clearinghouse of information related to issues facing the refuge and regional conservation community, such as tidal marsh restoration, deer management, public use effects and compatibility, and invasive species control. At the same time, the region is surrounded by many other organizations and agencies involved with fish and wildlife conservation. Defining our role in regional conservation is important to ensure the refuge protects those resources it can have the greatest impact on, minimizes duplication of efforts, and works with other organizations to achieve management goals. Several questions and comments were made asking us to consider various ways the refuge might embody a partnership or leadership role within regional conservation and associated issues. Our response to these concerns is discussed in chapter 4 under goals 1 through 5.

Visitor Services

John Heinz NWR was created with the specific purpose of promoting environmental education, as well as wildlife observation. With limited land available to promote species and habitat conservation, providing appropriate and compatible public use is an important issue addressed within this CCP. As with biological management, the issue of visitor services management encompasses a series of topics identified during the scoping process.

(1) How will the refuge continue to fulfill its original mandated purpose to create an environmental education center, and what types of programming and target audience will the refuge provide?

The refuge's location provides a great opportunity to introduce the public to the Service and Refuge System, and our role in conservation. With limited staff resources and several other environmental education providers within the region, identifying potential partnerships, the most receptive target audiences,

and unique educational components is critical for providing the most effective environmental education opportunities at the refuge.

Several comments were received from agency staff and the public regarding environmental education at the refuge. Several commenters noted that the refuge needs to improve and focus educational programming to engage urban youth in and around the City of Philadelphia. Other recommendations included the need to improve and update refuge displays and expand offsite education, including new digital and interactive media technologies. Our response to these concerns is discussed in chapter 4 under goal 3.

(2) What will the refuge do to improve its environmental interpretation, wildlife-dependent recreation, and compatible public uses?

The refuge offers numerous opportunities for environmental interpretation by maintaining 10 miles of hiking trails, interpretive signs, displays, and kiosks, as well as sponsoring several public events focused on fish, wildlife, habitat, and their conservation. The majority of refuge visitors participate in self-guided interpretive or wildlife-oriented recreation, outside of planned programs and events.

Most refuge visitors access the refuge on foot for purposes of wildlife viewing, photography, fishing, environmental education programs, or exercise. Additional, but restricted, access is allowed for bicyclists and vehicles used by people with disabilities, where compatible with refuge management. Due to the location and surrounding urban context, there have been several requests to incorporate at least a portion of the refuge's trail system into local and regional bicycle trails. Recommendations have been made to improve access to the tidal marsh through new trails, viewing platforms, or shuttle buses as well as development of eco-tourism with nearby businesses. Determining what access is desired and compatible with the Refuge System mission, as well as feasible on the refuge, will be required to make the appropriate improvements to public accessibility.

We have also received requests to improve access and interpretive facilities at the refuge's west entrance near the SR420 entrance located in Delaware County (see map 3.3). With limited space and staff resources, identifying the most receptive target audiences and effective interpretive components are important for effectively accomplishing our goals for interpretation. Our response to these concerns and recommendations is discussed in chapter 4 under goals 4 and 5.

(3) What will the refuge do to educate the public about local cultural resources on or around the refuge?

The refuge location and surrounding lands are significant not only from a natural resource standpoint, but also for cultural history. To date, the refuge has not incorporated many components of the regional cultural history into its education and interpretation. Opportunities to tie into the rich Philadelphia-area settlement history, Lenni-Lenape culture, as well as showcasing natural history topics, such as the changing history of conservation and attitudes towards wetlands, have been recommended for the refuge to consider incorporating into its public use programs. Historic and cultural programs can also attract a wider audience and can introduce new individuals to conservation and stewardship. Considering how, when, and what aspects of cultural history to incorporate into the refuge education and interpretation need to be defined in light of existing and proposed programs, their goals, and available resources. Our response to these concerns and recommendations is discussed in chapter 4 under goals 3 and 4.

(4) How will the refuge utilize partnerships with area agencies, businesses, and organizations to benefit resource conservation and visitation?

Despite the focus of management on the refuge, there are many partners within the surrounding region that can complement or support refuge programs related to education, interpretation, biological management, and public use. The partnerships we develop can have lasting benefits to refuge resources and promoting the Refuge System mission. We continue to partner closely with the Friends of the Heinz Refuge to accomplish a variety of refuge goals related to biological management and environmental education and interpretation.

Several possibilities for partnerships and ways they may benefit the refuge were identified in comments from both agency partners and the public. Fostering transportation and tourism-based partnerships with Philadelphia International Airport, Southeastern Philadelphia Transportation Authority (SEPTA), and the city of Philadelphia has potential to yield increases in visitors. The refuge was encouraged through public comment to cooperate and “cross-market” to audiences with other local and regional historic sites and conservation organizations to increase visitation. Participation and coordination with other local organizations and agencies can reduce duplicate efforts and enhance participation in events and programs. Identifying and developing partnerships throughout the region takes time and careful consideration to ensure results and compatibility with refuge goals and objectives. Our response to these concerns and recommendations is discussed in chapter 4 under goals 1 through 6.

Issues and Concerns Outside the Scope of this Analysis

We derived the following concerns and issues from public and partner meetings and further team discussions. These topics listed below fall outside the jurisdiction and authority of the Service or were deemed impractical. As a result, they are not discussed further within this plan.

(1) How will the refuge address degraded water quality entering the refuge and its associated impacts on fish and wildlife?

The water quality at the refuge is determined by the combination of waters from Darby Creek, Cobbs Creek, and the Delaware River. Philadelphia Water Department and other local, regional, and State agencies have conducted a series of watershed assessments and water quality characterizations that have detailed the water quality impacts related to urbanization and other watershed impacts. Other smaller streams (such as Muckinipattis and Hermesprota Creeks) directly connected to the refuge may also pose important considerations for water quality. Organic loading and pathogens are a growing water quality concern from State agencies in the Darby Creek watershed. Many water quality issues are watershed-scale concerns. The refuge, located at the base of the watershed, requires an understanding of these impacts and water rights and regulations to most effectively manage for environmental health.

Addressing the sources of degraded water quality requires a proactive, watershedwide, and multijurisdictional approach. We do not have the regulatory authority to adequately address the variety of nonpoint source pollution inputs that are impacting the refuge. We acknowledge that water quality plays an important role in the environmental health of the refuge. As a result, we will explore options for improving our monitoring of water quality as it relates to management on the refuge. As opportunities arise, we will support partner organizations to address water quality concerns that would directly benefit the refuge. These approaches are discussed in chapter 4 under goals 1 and 2.

Chapter 3

Elizabeth Jackson/USFWS



Great egrets within the 145-acre impoundment at John Heinz National Wildlife Refuge at Tinicum

Existing Environment

- 3.1 Introduction
- 3.2 The Physical Landscape
- 3.3 The Cultural Landscape Setting and Land Use History
- 3.4 The Current Climate and Potential Effects of Climate Change
- 3.5 Air Quality
- 3.6 Soils
- 3.7 Hydrology and Water Quality
- 3.8 Noise and Soundscapes
- 3.9 Socioeconomic Landscape
- 3.10 Refuge Administration
- 3.11 Refuge Natural Resources
- 3.12 Refuge Biological Resources
- 3.13 Special Use Permits, Including Research
- 3.14 Refuge Visitor Services Program
- 3.15 Archaeological and Historical Resources

3.1 Introduction

This chapter describes the current and historic physical, biological, and socioeconomic landscape of John Heinz NWR. Included are descriptions of the physical landscape, the regional context and its history, and the refuge environment, including its history, current administration, programs, and specific refuge resources. Much of the information included herein was originally compiled in the HMP (appendix C). Since then, several new studies and reports related to aspects of climate change, biological management, and socioeconomic demographics have been released. Those reports have been reviewed by the planning team and incorporated into the summary provided here.

3.2 The Physical Landscape

Watershed Context

John Heinz NWR is located within the Delaware River Basin, which encompasses 13,600 square miles and stretches approximately 330 miles from headwaters in New York State to its confluence with the Atlantic Ocean. The Delaware River watershed includes portions of Delaware, Maryland, New York, New Jersey, and Pennsylvania (DRBC 2004).

Within the Delaware watershed, the pre-industrial landscape was predominantly woods and wetlands, with expanses of farmland and small areas of human settlement. Decades of development and harvesting resulted in filled wetlands and a decrease of forests (DRBC 2004).

The refuge is located near the confluence of Darby Creek and the Delaware River located on the southwest boundary of the city of Philadelphia. Most of the 77 square miles of the Darby Creek watershed lies within Delaware County with additional portions found within surrounding Chester, Montgomery, and Philadelphia Counties. The watershed is very urbanized, encompassing all (or parts) of 31 municipalities, which are home to approximately 500,000 people, with an average density of nearly 10 persons per acre (DCVA 2005).

Geologic Development

John Heinz NWR is situated within Pennsylvania's southeastern most physiographic province, the Atlantic Coastal Plain (Low et al. 2010). This province extends from southern Delaware County up into Philadelphia County where it includes all of Philadelphia except the northwestern part. Outside of Pennsylvania, this province extends throughout areas along the Atlantic Ocean from Massachusetts to Florida, including all of southern New Jersey and most of Delaware.

This physiographic region is characteristically flat land with sandy soils. These soils are primarily composed of sand, silt, and gravel resulting from the weathering of very old Paleozoic and Precambrian metamorphic rocks. This rock, originally laid down as sediments 438 to 1,600 million years ago, was altered by heat and pressure to form various metamorphic rocks, which in turn weather relatively easily.

The refuge is influenced by the Delaware River and its soils are in a different group. Soils on the refuge are composed of sand and gravel laid down by periodic flooding over the last 1.6 million years with additional silt and clay deposits where finer material was able to settle. Alluvial sediments in areas along this reach of the Delaware River were deposited over the last 12,000 years (PNHP 2008). These finer alluvial sediments are those which naturally comprise much of the soils throughout the refuge. PADCNr (2010b) has highlighted Tinicum Marsh as an Outstanding Scenic Geological Feature worth noting within this physiographic province.

3.3 The Cultural Landscape Setting and Land Use History

Pre-European Habitat

The pre-settlement forest of southeastern Pennsylvania was a mixed-aged forest (Latham et al. 2005). In areas along the Delaware River, the coastal plain forest type covered a significant portion of the Philadelphia area. This community supported a suite of species common farther south. This community developed in this region because of the sandy soils combined with the warm coastal air blown up from Delaware Bay. This forest type was dominated by sweet-gum (*Liquidambar styraciflua*) and oaks (*Quercus spp.*) intermixed with species such as American beech (*Fagus grandifolia*). The understory would have also included broadleaved evergreen species such as American holly (*Ilex opaca*) (PNHP 2008).

Floodplain forests were also found along many river systems in this part of the State. These forests would have been regularly flooded, for various durations, on an annual basis. In the most frequently flooded areas, fast-growing species such as sycamore (*Platanus occidentalis*), silver maple (*Acer saccharinum*), and American and slippery elm (*Ulmus americana* and *U. rubra*, respectively) would dominate. Associated species would include eastern cottonwood (*Populus deltoides*), common hackberry (*Celtis occidentalis*), black walnut (*Juglans nigra*), butternut (*Juglans cinerea*), green ash (*Fraxinus pennsylvanica*), and box-elder (*Acer negundo*) interspersed among them. Permanently wet or saturated areas, such as backwaters and isolated oxbows, would have supported swamp white oak (*Quercus bicolor*), pin oak (*Quercus palustris*), and red maple (*Acer rubrum*).

Grasslands and native meadows were likely to be found throughout the Philadelphia area prior to colonization. However, it is unlikely that these were self-maintaining systems. Meadows were often managed by resident Native Americans who burned them on a periodic basis to prevent their succession back to forest partly in order to provide forage for game species such as grouse, turkey, deer, and elk (Latham et al. 2005).

The Pennsylvania Natural Heritage Program estimates that Philadelphia County at one time contained 10 to 20 square miles (6,400 to 12,800 acres) of freshwater tidal marsh (PNHP 2008). Historically, and as it is today, these wetlands provided an important breeding spot for many bird, mammal, fish, amphibian, reptile, and insect species. It was also a critical stopover site for migratory waterfowl and shorebirds during their annual migrations. Today, John Heinz NWR protects approximately 282 acres of the freshwater tidal marsh, the largest remaining fragment of this habitat in the State (PNHP 2008).

Pre-European Settlement

Human occupation of the lower Delaware River drainage likely began as early as 16,000 years ago with the arrival of the ancestors of the Lenni-Lenape people, known to the English as the Delawares. This reach of the river was narrower and nontidal at that time, flowing through forested floodplain and freshwater marshes. Sea level rise had already been initiated by melting of the Wisconsin ice mass far to the north, and continued at a gradually slowing pace until about 5,000 years ago. By this time the local environment had stabilized as a tidal estuary with marshes comprising not only most of the current refuge land, but also a large part of the area now covered by Philadelphia International Airport.

As a result of the destruction caused by intensive historic period development, remarkably few archaeological sites dating from prior to European contact have been found in Philadelphia or its surrounding boroughs. The earliest recorded sites within the city date from approximately 5,000 years ago although, it is likely

that earlier ones existed and some may still exist in small and scattered areas of undeveloped land.

Within the Tinicum Township, the landscape of the refuge consists entirely of tidal marsh overlaid by a system of dikes. Some of the dikes are wide enough to support trees and brush on their edges, but close examinations of early maps and photographs reveal no natural islands. The only refuge areas suitable for Pre-Contact Native American occupation consist of two narrow strips of terrace on the north side of Darby Creek in Folcroft and a larger area within the Eastwick portion, containing the refuge headquarters and maintenance areas. These areas were farmland in the early 20th century but are now forested. These areas may retain some archaeological potential, though the immediate vicinity of the refuge headquarters consists of a deep and remarkably extensive modern fill.

European Settlement

Soon after European settlement in the mid-17th century farmers began to extensively dike and ditch tidal marsh to convert it to hayfields. Portions of the refuge dike system follow the trace of dikes dating from the mid-19th century, and likely considerably earlier. That earlier dike system was modified in the mid-20th century by installation of various water control structures, widening of virtually all dikes for construction of roads on top of them, construction of interior dikes at some locations, and erosion of considerable lengths that fell out of use. The ditch system, poorly represented on historic maps but visible in early 20th century photographs, has almost completely vanished due to modern erosion and siltation. There are no standing historic structures on the refuge. The only dwelling sites recorded are two farmsteads established in the 1870s or earlier, both of which were obliterated by bridge construction and widening of South 84th Street in the 1970s.

20th Century Influences

Events that destroyed or highly altered what are now refuge lands over the 20th century are well documented in *Two Studies of Tinicum Marsh* (McCormick et al. 1970). One of the first impacts of the 20th century was the construction of the Philadelphia and Chester Railway Company, a trolley service that provided direct transit between Chester and Philadelphia from 1901 to November 1946 (Schieck and Cox 1970). This former trolley bed runs parallel to the refuge's southern access road. While the trolley bed is not within the refuge boundary, its construction impacted current refuge lands with extensive cut and fill operations along its corridor. Aerial photos of the refuge area from 1928 document the presence of extensive marsh as well as several dike and road systems (figure 3.1). The trolley bed continues to affect the hydrology and drainage in the area of the impoundment.

The 1930s saw numerous, and expensive, repairs and alterations by the U.S. Army Corps of Engineers. The Federal Works Program Administration, Pennsylvania legislature, and Delaware County all provided funds to repair the dikes along the southern edge of Darby Creek. In 1935, a proposal for mosquito control led the U.S. Army Corps of Engineers to construct a series of ditches throughout Tinicum Marsh. Some of these artificial channels are still visible today in the northern half of the freshwater tidal marsh. From the 1930s until the 1950s, several areas within and around Tinicum Marsh were utilized by the U.S. Army Corps of Engineers for landfills of dredged material (McCormick et al. 1970).

The early 1970s saw the construction of Interstate 95 (I-95) and an interchange system with State Route 420. These major projects resulted in the dredging and filling of many marsh areas around the refuge. Today, these areas remain as permanent open water features where dredging occurred and as either degraded floodplain forest or wetlands dominated by phragmites.

The Folcroft Landfill operated from the 1950s through the 1970s accepting municipal, demolition, and hospital waste. It was closed in 1973 as a result of permit violations and improper management. Closing activities included regrading of the landfill, reducing steep slopes along with covering, and seeding the site (USEPA 2006).

Figure 3.1. Aerial photograph of John Heinz NWR lands in 1928 (prior to refuge establishment). Note the presence of extensive marsh and wetlands surrounded by agriculture.



In 1980, Congress authorized the purchase of the Folcroft Landfill to increase the size of the refuge. At this time, a potentially responsible party group is conducting a remedial investigation of the landfill pursuant to an administrative order on consent with the USEPA (USEPA 2006). Refuge staff is working with USEPA to facilitate the landfill cleanup efforts.

In 1991, through a bill sponsored by Congressman Curt Weldon, the Tinicum Wildlife Preserve officially became John Heinz National Wildlife Refuge at Tinicum in honor of the late Senator who was influential in the marsh's preservation.

In February 2000, a subsurface pipeline owned by Sun Pipe Company and operated by Sunoco, Inc. ruptured, releasing 191,982 gallons of crude oil into the 145-acre impoundment in the refuge. At the time of the release, the impoundment contained a thick layer of ice that formed a natural barrier which prevented the oil from spreading throughout the impoundment. At its peak, the area affected by the oil spill encompassed approximately 1.6 acres. This included the oil slick floating under the ice and an area of shoreline adjacent to the slick containing emergent, scrub-shrub, and forested wetlands. Sunoco provided initial response personnel to secure the site and to begin the initial cleanup operation. More than 90 percent (173,799 gallons) of the spilled oil was recovered through the cleanup effort. In addition to the 1.6 acres directly impacted by oil contamination, another 1.25 acres were directly impacted by response vehicles and equipment.

Shortly after the oil leak was discovered and concurrent with the initial cleanup efforts, the Service, the PFBC, and the Pennsylvania Department of Environmental Protection (PADEP) initiated a cooperative Natural Resource Damage Assessment. Subsequently, USEPA Region III issued a

Unilateral Administrative Order for the Abatement of Endangerment that required “restoring all areas, including soils and sediments, to the maximum extent possible, to their condition before the discharge of oil.” Sunoco and the participating agencies developed a restoration plan. Restoration efforts were completed and a final report was submitted to the USEPA on June 3, 2005 (Entrix, Inc. 2005).

Additional information on the history and cultural resources of the refuge and surrounding lands are identified in the Phase I Archaeological Survey Report developed for the Clearview Landfill, part of the Lower Darby Creek Area Site (Kim and Teamerson 2011). This report is available online at the USEPA’s Lower Darby Creek summary Web site.

Wildlife and Habitat Changes

Habitat loss and degradation is the single greatest cause of loss or decline of species across the globe (and in Pennsylvania), threatening over 80 percent of rare and endangered species (Wilcove et al. 1998). Invasive species that compete with or reduce populations of native species are the second greatest cause of declines (affecting over 50 percent of terrestrial species). In Pennsylvania, an estimated one-third of all plants are nonnative, and 11 percent of all fish are nonnative (Goodrich et al. 2001).

Maps of the refuge area dating back to the late 1700s show an area largely comprised of wetlands—likely freshwater tidal marsh, as it was historically present along the Delaware River. Over the following two centuries, agriculture and urbanization slowly encroached on these wetland areas. John Heinz NWR today is largely an island of habitat within its urban surroundings. As a result, large predators and other species that would have once inhabited the area are now gone.

The PADCNr compiled an overall habitat quality rank by using estimates of habitat quality for streams, wetlands, forests, and grasslands index for each physiographic region throughout the State. This ranking highlights coastal plain habitats as the only “impaired” habitats within Pennsylvania and highlights the coastal plain region as being home to some of the last remaining habitats for certain wetland species in the State. The 2001 PADCNr report *Wildlife Habitat in Pennsylvania, Past, Present, and Future*, recommends that where possible, wetlands along the Delaware should be restored. Urban forests could be focal points to provide habitat for some tolerant forest wildlife. Reduction of runoff into streams and wetlands should be top priority, along with restoration of natural communities in undeveloped areas (Goodrich et al. 2001).

The Refuge, the Land, and the People

The cultural history of the region reflects changing societal values in the U.S. The Lenape and earlier indigenous people, along with European explorers and settlers valued the marshes and adjacent uplands for agriculture, fishing, and hunting along with its strategic location for trade and transportation. Undoubtedly, this area’s ongoing relationship with different cultures and land ethics throughout the centuries has had many impacts on the refuge as it is known today.

As the Tinicum region developed, the perceived value of marshes diminished for the public, which resulted in the fill or dredging of many acres of wetlands. The history of the refuge over the past 50 years reflects a renewed and refined sense of ecological value in respect to habitat protection and conservation.

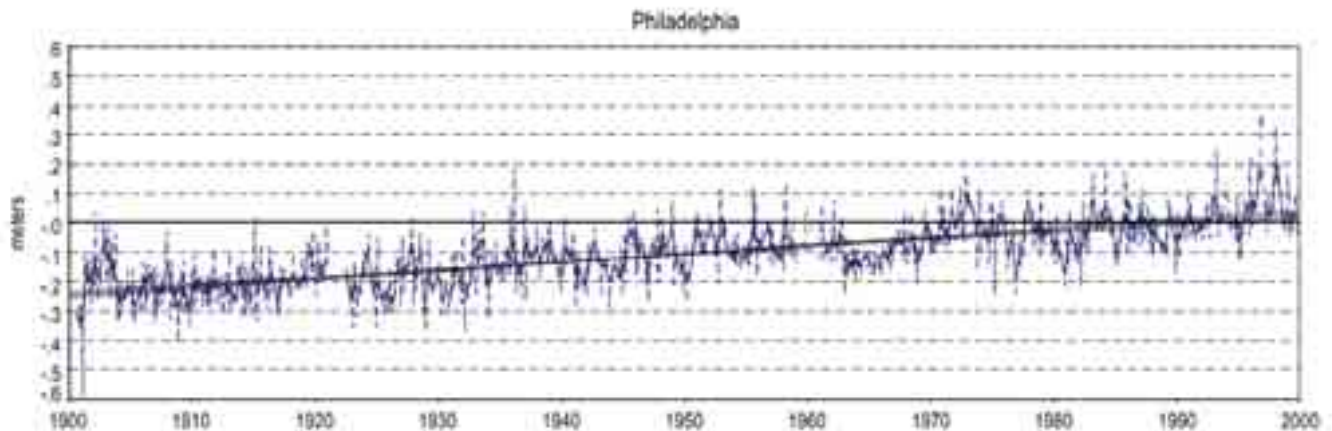
3.4 The Current Climate and Potential Effects of Climate Change

The coastal climate of the Mid-Atlantic is characterized by seasonal variations from hot and humid summers to cold winters. The average summer temperature is around 75 °Fahrenheit (F), while the average winter temperature is 33 °F. Average precipitation totals around 46 inches per year, with an average annual

snowfall of around 30 inches (NRCC 2006). July tends to be the warmest and wettest month with an average temperature around 85 °F and average monthly rainfall around 4.38 inches. Along with the moderating effects of the coastal climate, hurricanes, tropical storms, and Nor'easters can provide extreme precipitation events (NRCC 2006). In recent years, these large events have caused flooding in and around the refuge.

Like many areas throughout the world, the climate of southeastern Pennsylvania is changing. Over the past century mean annual temperature has risen 0.5 °F (UCS 2008). Sea level, as measured by a tidal gauge at Philadelphia, has also risen nearly 1 foot over the past century as shown in figure 3.2 (NOAA 1999).

Figure 3.2. Monitored Sea Levels at Philadelphia, Pennsylvania (1900 to 2000). Note the nearly 1-foot rise in sea level over the past century (NOAA 1999).



Climate change and sea level rise projections for the region will potentially have major influences over the habitats of John Heinz NWR and their management over the coming decades. As with other areas throughout the world, the precise ecological impacts to John Heinz NWR from a changing climate are largely unknown at this time. Detailed monitoring of habitat conditions and species utilization will be necessary to identify potential shifts in species assemblages or distribution across the refuge and region. However, reports and guidance documents published in recent years provide projections and estimates upon which the refuge can begin to build an understanding of how these potential impacts may manifest themselves and impact the refuge.

According to a recent report released by the Union of Concerned Scientists, temperature projections for the coming decades (2010 to 2039) may make eastern Pennsylvania's climate more closely resemble that of Maryland or northern Virginia as we know it today (UCS 2008). Philadelphia and other large cities already experience extreme heat and air pollution events. The Intergovernmental Panel on Climate Change (IPCC) projects that urban areas throughout North America will experience more severe and longer heat waves and increased impacts from air pollution (UCS 2008). In their *Summary Report for Policymakers*, the IPCC warns with "very high confidence" that these extreme temperature events may lead to increasing impacts on forests through disturbances from pests, diseases, and extended periods of high risks of fire. It is important to note that "very high confidence" is defined as a 9 in 10 likelihood of occurrence (IPCC 2007).

Recent estimates by the IPCC for global sea level rise could have serious implications for the freshwater tidal marsh within John Heinz NWR. Conservative estimates project a rise between 7 and 14 inches over the next century, while higher estimates range between 10 and 23 inches (UCS 2008). Najjar et al. (2000) estimate global sea level rise between 0.4 to 1.2 inches by 2030 and between 1.6 to 4.0 inches by 2095. Another recent estimate shows relative sea level rise (which accounts for mean sea level rise and land subsidence) may increase 2.6 to 5.6 feet by the end of the century (Kreeger et al. 2010).

Sea levels have fluctuated over many millennia. Tidal marshes (both salt and freshwater) typically respond to these fluctuations through two mechanisms: accretion of sediment across the marsh surface (i.e., a rising of the marsh surface elevation) or expansion into nearby (and topographically higher) riparian lands (i.e., conversion of surrounding lands) (Odum et al. 1984). Due to the unique landscape context of John Heinz NWR being situated within the Philadelphia metropolitan area, at the base of a highly urbanized watershed and at the confluence of Darby Creek with the Delaware River, the refuge's freshwater tidal marsh is particularly vulnerable to changing sea levels. Given this level of urbanization in the Darby Creek watershed, it is unclear which, if either, of these options may allow the necessary adjustment to rising sea levels.

In addition to the rise in water levels alone, the salt line of the Delaware River¹ has potential to shift upstream and into the zone encompassing the refuge. Currently, the refuge is less than 1 mile upstream from the salt line. The intrusion of salt water is problematic for freshwater tidal marshes and freshwater tidal swamps that cannot tolerate salinities greater than 0.5 milligrams per liter. Not only plants, but animal and microbial communities will be altered by salt intrusion (Weston et al. 2006, Craft et al. 2008). As plants with a low salt tolerance become stressed, less productive and die, marsh communities shift to salt-tolerant species.

A major shift in the salinity of waters within John Heinz NWR could lead to a major shift in plant communities and species within areas which are currently freshwater tidal marsh. Neither the effects of sea level rise on marsh elevations nor salinity levels are well understood within the Delaware Bay at this time, although preliminary analysis shows that the estuary has increased in salinity over time (Kreeger et al. 2010). Monitoring these influences over the coming years will be a major step in developing management options for the refuge into the future.

In an effort to address the potential effects of sea level rise on U.S. national wildlife refuges, the Service's Northeast Region contracted the application of SLAMM for most of its refuges with tidal waters. This analysis was initiated to inform the decisionmaking process as part of CCP development for each refuge along with other long-term management plans. Changes in tidal marsh area and habitat type in response to sea level rise were modeled using the SLAMM 6.0. This model accounts for the dominant processes involved in wetland conversion and shoreline modifications during long-term sea level rise (Park et al. 1989, Warren Pinnacle 2011).

¹ This is the zone where low-salinity freshwaters from the Delaware River watershed combine with high-salinity waters from Delaware Bay (characterized as having a concentration of 250 milligrams per liter (mg/L) sodium chloride).

For John Heinz NWR's analysis, SLAMM 6.0 was run using scenario A1B from the Special Report on Emissions Scenarios — mean and maximum estimates. The A1 scenario assumes that the future includes very rapid economic growth, global population that peaks in mid-century and declines thereafter, and the rapid introduction of new and more efficient technologies. Under the A1B scenario, the IPCC WGI Fourth Assessment Report (IPCC 2007) suggests a likely range of 0.7 to 1.6 feet (0.21 to 0.48 meters) of sea level rise by 2090 to 2099 “excluding future rapid dynamical changes in ice flow.” The A1B-mean scenario that was run as a part of the refuge-specific analysis falls near the middle of this estimated range, predicting 1.3 feet (0.40 meters) of global sea level rise by 2100. To allow for further analysis, SLAMM was also run assuming 3.3 feet (1 meter), 4.9 feet (1.5 meters), and 6.6 feet (2 meters) of global sea level rise by the year 2100.

According to the SLAMM analysis conducted, John Heinz NWR is predicted to experience significant effects of sea level rise. Undeveloped dry land, which makes up roughly one quarter of the refuge, is predicted to be lost at a rate between 24 percent and 54 percent (66 to 145 acres respectively) across the range of sea level rise scenarios. Tidal freshwater marsh, which makes up roughly one third of the refuge, is predicted by to be lost at a rate of 9 percent to 84 percent (approximately 14 to 352 acres respectively) once scenarios exceed 1.3 feet (0.39 meters) of global sea level rise (Warren Pinnacle Consulting 2010). According to these results, the refuge will begin to see the most drastic effects of sea level rise once it exceeds 2.3 feet (0.69 meters). These levels of sea level rise would result in major shifts in the habitat types and species composition across the refuge (table 3.1). Appendix I provides more information on the SLAMM analysis and the predicted impacts of sea level rise on John Heinz NWR.

Another concern related to sea level rise is increasing salinity. Increasing sea levels will result in larger tidal volumes that carry more salt water higher up into the estuary. Sea level rise could increase the tidal range in the Delaware system (Walters 1992). Tidal range changes would also likely increase the salinity range over the tidal cycle (Kreeger et al. 2010). A preliminary analysis, completed by Dr. Najjar of Pennsylvania State University, reviewed existing salinity measurements dating back to 1927 to document trends in salinity within the Delaware Estuary. His results suggest that salinity is increasing at a rate greater than can be explained by streamflow and models of the response of salinity to sea level. This phenomenon could be a result of other forces in the estuary, such as successive channel deepening events that occurred during the period of analysis, which could have also contributed to salinity intrusion due to larger tidal volumes and bathymetric changes (Kreeger et al. 2010). Due to such complexities in determining salinity migration at the upper end of the estuary, modeling of potential changes in salinity resulting from sea level rise could not be completed at the time of this writing.

Again, the IPCC warns with “high confidence” (or an 8 in 10 chance) that, “the resilience of many ecosystems is likely to be exceeded this century by an unprecedented combination of climate change, associated disturbances (e.g., flooding, drought, wildfire, insects, ocean acidification) and other global change drivers...” (IPCC 2007). Heavy rain and snow events are anticipated for many parts of North America. For John Heinz NWR, being at the base of the Darby Creek watershed which is already highly urbanized and experiencing frequent flooding, this prediction would likely lead to more frequent flood events over the coming decades.

Table 3.1. Predicted Net Loss of Habitat Types at John Heinz NWR Using a Simulated Scenario of a 2.3 feet of Sea Level Rise through 2100.

Habitat Type	Predicted Acreage by Habitat Type				
	Initial	2025	2050	2075	2100
Tidal Fresh Marsh	419.7	406.7	401.2	395.7	381.2
Undeveloped Dry Land	268.0	217.5	209.8	200.4	176.2
Inland Open Water	184.6	164.5	164.6	164.4	163.9
Riverine Tidal	145.0	68.9	67.6	60.7	59.6
Inland Fresh Marsh	66.5	62.5	62.5	62.3	47.3
Tidal Swamp	61.6	58.7	58.0	56.6	54.8
Developed Dry Land	41.6	36.3	35.4	34.2	32.6
Inland Shore	7.8	6.7	5.5	4.2	3.2
Estuarine Open Water	0.0	97.6	104.9	123.3	140.2
Tidal Flat	0.0	0.0	28.6	23.9	20.1
Regularly Flooded Marsh	0.0	55.2	25.9	33.5	38.1
Transitional Salt Marsh	0.0	18.1	22.2	26.0	60.0
Irregularly Flooded Marsh	0.0	1.9	8.6	9.6	17.7
Total Acreage (including water)	1,194.7	1,194.7	1,194.7	1,194.7	1,194.7

Over the last century, the annual average temperature in Pennsylvania increased by over 0.5 °F (UCS 2008, NOAA 2008). This warming has resulted in many climate-related changes such as more frequent days with temperatures above 90 °F, a longer growing season, increased heavy precipitation events, less winter precipitation in the form of snow and more as rain, and rising sea surface temperatures and sea level (Hayhoe et al. 2007).

Being located in a physiographic region (the piedmont and coastal plain) where the ranges of many species overlap between northern and southern regions, the area's plant, fish, and animal populations are diverse. These shifts in temperature and precipitation will likely impact the plant and animal populations adapted to the historic climate of the Mid-Atlantic. As summers are projected to become warmer across the Northeast, many plant species are likely to shift ranges northward (Iverson et al. 2008).

As outlined in earlier chapters, the refuge has acted as an ecological oasis within the highly urbanized lands surrounding Philadelphia. It has provided refuge for many species using its habitats for migratory stopovers, nesting, spawning, and feeding. Unfortunately, the isolation of the refuge from other natural areas will limit the ability of refuge habitats to respond to the predicted impacts of climate change. For example, marsh habitat will be unable to shift inland because of the urban development surrounding the refuge.

3.5 Air Quality

The Philadelphia Department of Public Health, Air Management Services, the local air pollution control agency for the city of Philadelphia, is responsible for the prevention, abatement, and control of air pollution and air pollution nuisances, achieving and maintaining Federal National Ambient Air Quality Standards in Philadelphia, and protecting the health and quality of life of the Philadelphia community from the adverse effects of air contaminants and noise (Philadelphia AMS 2010).

Philadelphia and its surrounding communities face many of the same air pollution challenges as other urban areas, mainly as emissions from vehicles and industries. The city of Philadelphia maintains a network of 10 air monitoring sites located throughout the city. Many of the monitoring sites measure in “real time” the criteria principal pollutants: ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, particulate matter (PM10 and PM2.5), and lead. Five of the sites also measure toxics, such as 1, 3-butadiene, benzene, and carbon tetrachloride.

Areas of Pennsylvania where air pollution levels consistently stay below these standards are designated “attainment.” Areas where air pollution levels persistently exceed these standards are designated “nonattainment” (PADEP 2011). According to the PADEP Bureau of Air Quality, Delaware and Philadelphia Counties are rated as moderate for attainment of the 1997 8-hour ozone standard of 0.08 ppm. These counties are also rated as “nonattainment” for standards related to particulate matter. Philadelphia County is also considered “nonattainment” for carbon monoxide standards (PADEP 2011).

Based on a preview of the results to State and local air agencies, air toxins in Philadelphia that show an excess lifetime cancer risk of greater than one in a million are: formaldehyde, benzene (including benzene from gasoline), acetaldehyde, 1,3-butadiene, carbon tetrachloride, naphthalene, chromium compounds, arsenic compounds (inorganic including arsine), polycyclic aromatic hydrocarbons and polyoxymethylene, tetrachloroethylene (perchloroethylene), and ethylene oxide.

In Philadelphia, motor vehicles account for up to 60 percent of the total air pollution, according to the USEPA (Clean Air Council 2011). According to the Delaware Valley Regional Planning Commission, I-95 immediately adjacent to and south of the refuge carries approximately 80,000 vehicles per day through Delaware County and South Philadelphia, and reaches a peak of 150,000 vehicles per day through Center City Philadelphia (DVRPC 2009). Bartram Avenue adjacent to the eastern refuge boundary carries about 20,000 vehicles per day (DVRPC 2009).

The Philadelphia Air Management Services maintains the area Air Quality Index. The Air Quality Index is based on the five criteria air pollutants: ground level ozone, particulate matter, carbon monoxide, sulfur dioxide, and nitrogen dioxide. Each pollutant is scored using formulas developed by the USEPA. Based on the Air Quality Index, the number of days with good air quality in Philadelphia steadily increased from 1990 until 1999 and then decreased until 2002 before again increasing and subsequently leveling off around 2005. In the same timeframe, the number of days with moderate air quality increased and leveled off (Philadelphia AMS 2010). Over the period from 1990 through 1998, the annual number of days with unhealthy air quality dramatically decreased and has remained about the same, roughly 23 days per year for each year since 2008 (Philadelphia AMS 2010). According to Philadelphia Air Management Services, these improvements can be attributed mainly to emission reductions from gasoline markets, including vapor recovery at retail gasoline stations, and companies shutting down pollution producing processes (Philadelphia AMS 2010).

3.6 Soils

The Soil Survey of Philadelphia County shows the lands of John Heinz NWR being comprised of marsh soils and urban land (i.e., organic and mixed fill) (NRCS 2009). As discussed in previous sections, the natural soil composition of most, if not all, of the refuge lands consisted of silty alluvial soils deposited over the last 12,000 years. However, significant soil disturbances that occurred during the 20th century altered the soil structure (and consequently the hydrology) of many areas in and around the refuge. Thus, most upland areas within the refuge are comprised of organic fill material. Despite this significant impact, many of the riparian forest communities that naturally occur within this region (coastal plain and floodplain forests) seemed to have established in many of these areas.

3.7 Hydrology and Water Quality

Hydrology and Geomorphology

John Heinz NWR is located at or slightly above sea level. Consequently, Darby Creek and the freshwater tidal marsh within the refuge experience a daily tidal fluctuation of around 6 feet. Darby Creek flows through the refuge just upstream from its confluence with the Delaware River. Collectively, the Darby Creek and Cobbs Creek (a major tributary of Darby Creek) watersheds drain approximately 74.1 square miles by the time they reach the refuge (USGS 2009).

As part of the Delaware Riverkeeper Network plan completed in 2005, baseline geomorphic stream data was collected and analyzed for trends in erosion and sinuosity from historic (1965 to 1990) and more recent (2000) aerial photographs along with topographic and other maps displaying the refuge area dating between 1757 and 2004. Darby Creek throughout much of the refuge is characterized by a braided stream channel with variable sinuosity. This channel type is common in coastal tidal streams near river deltas and tends to be a relatively stable channel. However, major changes to the stream or watershed such as loss of vegetation, channel alterations, and urbanization, can affect stream morphology and cause the stream channel to adjust significantly (e.g., cause erosion and deposition) (Salas et al. 2006).

The basic geomorphic assessment of Darby Creek and other tributaries within the refuge generally reflect this inherent stability and response to major impacts. The majority of streams within the refuge have remained relatively stable over the past 40 years and longer. Analysis of historic aerial photographs and other maps show Hermesprota and Little Thoroughfare Creeks and portions of Darby Creek appearing relatively unchanged. However, major changes have been noted on Bow Creek and on other portions of Darby Creek.

Bow Creek, which historically connected Darby Creek and the Delaware River across what is now Philadelphia International Airport, is today completely isolated from Darby Creek. Darby Creek itself has displayed several signs of adjustment, most notably during the 1980s. Analysis of aerial photos from 1980 and 1990 show that the multi-channeled Darby's main channel cut through the center of Tinicum Marsh, shortening its total length by nearly half (from 8,400 linear feet to 4,800 linear feet). It is unclear what influenced this dramatic shift or whether the blockage of Bow Creek may have influenced this alteration of Darby Creek. The channel has remained relatively unchanged since this last adjustment period.

Many of the areas in and around the refuge were historically freshwater tidal marsh. As discussed previously, loss and alteration of wetlands dates back centuries, as early as the first Dutch settlements of the 1640s, when many marsh areas around the Tinicum region were diked for agriculture. More recent losses of tidal marsh occurred between the 1950s and early 1970s, when several

areas of the refuge were filled or dredged. These large-scale disturbances, altered hydrology, invasive species introductions, and high levels of deer browse continually impact many of the natural communities within the refuge. As observed as part of Delaware Riverkeeper Network's field surveys conducted in 2005, these areas are typically dominated by near monocultures of nonnative invasive species, contain fill and debris, unnatural amounts of open water habitat, and lack proper ecosystem structure (Salas et al. 2006).

The refuge also contains a 145-acre open water impoundment. The impoundment as we know it today was likely constructed sometime during the 1940s or 1950s. Historically, the impoundment was managed as open water with periodic tidal fluctuation. Two water control structures are still in place along portions of the impoundment dike. However, these structures became unusable as Darby Creek's channel pattern shifted further away from the dike in these locations during the early 1980s. This caused the structures to become silted in. Today, the refuge maintains an additional active water control structure in the northwest corner of the impoundment.

Water Quality

The refuge is located within highly urbanized and industrial surroundings, making it vulnerable to many factors that could negatively affect ecosystem and wildlife health. Point source and nonpoint source pollution within the Darby Creek watershed and Delaware Estuary affects water quality and available food chain support for ecosystems providing habitat at the refuge.

Water quality in the refuge is the result of the inputs to three major waterways: Darby Creek, Cobbs Creeks (a major tributary to the Darby), and the Delaware River. The contribution from each of these sources varies depending upon hydrologic, climatologic and anthropogenic conditions. Thus, the water quality found in the refuge is highly variable and complex. The status of water quality and aquatic life is determined by various chemical, physical and biological parameters. For management purposes, the tidal portions of Delaware River tributaries are considered to be part of the river. Twice each day, river water enters the Darby Creek system during high tide. In addition, various fish species freely move between Darby Creek and the Delaware River. Because of these factors, the tidal portion of Darby Creek is considered part of the Delaware River Basin Commission's Interstate Pollution Control Zone 4 (DRBC 2004). A zone-by-zone assessment of the attainment of designated water quality uses by the Delaware River Basin Commission indicated that Zone 4 attained its recreational designated uses, but not its aquatic life uses (DRBC 2004).

Data for Darby and Cobbs Creeks have been collected by the PADEP, the U.S. Geological Survey (USGS), the Philadelphia Water Department, Darby Creek Valley Association, the Academy of Natural Sciences, and others. Long-term monitoring of the tidal Delaware River occurs through the Delaware River Basin Commission with the Delaware Department of Natural Resources and Environmental Conservation conducting the sampling via contract from Delaware River Basin Commission. The refuge is fortunate that a number of reports have been produced that describe the status of the Darby Creek watershed based on recent data: the Darby Creek Rivers Conservation Plan (DCVA 2005), Lower Darby Creek Area 33 USEPA Facility Report (NOAA 2000), and the Darby-Cobbs Characterization Report (PWD 2004).

During the early 20th century, the Delaware River in the vicinity of Philadelphia and Camden was the most polluted stretch of river in the U.S., if not the world (Albert 1988). In September 1946, no dissolved oxygen was found in this reach of the river; a "dead zone" that extended for more than 20 miles. In the intervening years, a massive effort was made to clean up the Delaware Estuary. By the mid-

1980s, major reductions in nutrient pollution resulted in needed water quality improvements. The reach where Darby Creek enters the Delaware has shown substantial improvement in this regard.

Fish data collected in recent years indicate that Darby Creek's species diversity has increased over previous levels, including some pollution-intolerant species. Environmental health metric scores based on fish populations suggest that the downstream reach of Darby Creek is "good," although upstream locations were "fair" or "poor" (PWD 2004). Cobbs Creek fish metrics indicate only "fair" or "poor" environmental health scores (PWD 2004).

Environmental Contaminants

Environmental contaminants have an impact on wildlife present on the refuge. The Folcroft Landfill, which became part of the refuge in 1980, is part of the Lower Darby Creek Area Superfund Site. The Lower Darby Creek Area includes four other sites within a 2-mile stretch along Darby Creek (NOAA 2000). Of the five sites, only Folcroft Landfill is located on the refuge. Coordination with the USEPA regarding contaminant remediation is ongoing. USEPA currently maintains authority over the remediation of the site. The Service currently owns this property and will ultimately take on management of it once the legal cases are settled and site closure is completed.

Over the years, aquatic life uses, as determined by PADEP and the PFBC were not attained because of widespread fish advisories in the river and various tidal tributaries, not including Darby Creek. These advisories are the result of contaminants found in fish, including polychlorinated biphenyls.

In 2003, staff from the Service's Chesapeake Bay Ecological Services Field Office, assisted by the Pennsylvania Ecological Services Office, collected 31 brown bullheads (*Ameiurus nebulosus*) as part of a study on the effects of polycyclic aromatic hydrocarbons in urbanized watersheds. The main objective was to determine the prevalence of liver and skin tumors, lesions that precede tumor development, and barbel abnormalities. Their findings reported a 26 percent prevalence of liver tumors and a 6 percent prevalence of skin tumors in brown bullheads (less than 260 mm in length) from Lower Darby Creek. Liver tumor prevalence is indicative of a contaminated habitat. Levels of liver tumors found were more than five times the Baumann (2002) criteria for distinguishing highly contaminated Areas of Concern from less contaminated Areas of Recovery (Pinkney et al. 2004).

A large crude oil spill in 2000 located on the refuge impacted the reproduction of resident turtle populations. Research was conducted to determine the effect of crude oil exposure on female snapping turtle and painted turtle fertility, reproductive output, and development of offspring. There was no significant difference in egg fertility between female snapping turtles exposed to oil or control turtles. However, female snapping turtles had significantly lower fertility of eggs in 2002 compared to 2000. There was no difference in reproductive output between exposure groups or years for snapping turtles or painted turtles. Most snapping turtle embryos died early in development, and there were significantly more early deaths for oil exposed snapping turtles than controls. Control painted turtles not only had a higher incidence of abnormality than control snapping turtles, but malformations were more severe in the former than the latter. Oil exposure exacerbated developmental problems in snapping turtles, causing increased incidence and severity of deformity in embryos.

The study noted that both species exhibit high rates of embryonic and adult deformity and that although the refuge offers many advantages to the resident turtle populations, background pollution places a developmental burden on the

3.8 Noise and Soundscapes

life history of turtles that was exacerbated by exposure to crude oil. Despite the deformities documented in both oil exposed and control turtles, exposure to crude oil did not appear to have significantly affected the fertility or relative clutch size of snapping turtles or painted turtles (Bell 2005).

John Heinz NWR is northwest of the Philadelphia International Airport and is separated from the airport by I-95, a SEPTA rail line, and Bartram Avenue. The refuge is not aligned with any existing runway and is not on the direct approach or departure track for any of the existing runways. The noise analysis completed for a runway expansion project environmental impact statement demonstrated that the refuge experiences noise levels between 45 and 60 decibels (dB) based on the Day-Night Average Sound Level (DNL) recorded near the refuge. A noise monitoring site on Lindberg Boulevard south of the refuge showed an average DNL of 50 dB. This is calculated to increase to 55.4 dB in 2007 and 56.5 dB in 2015 with the runway expansion project (PHL 2005).

These noise levels are considered compatible with the outdoor recreational use of the refuge in accordance with Federal Aviation Regulations Part 150 criteria for compatible land use (PHL 2005). However, we and other conservation partners are concerned about the ongoing impact of noise on wildlife present on the refuge. Noise generated from I-95 and Philadelphia International Airport, may adversely affect foraging of some species dependent on echolocation, including songbirds, bats, and frogs (Cohen and Johnson 2004, Siemers and Schaub 2010).

Noise impacts on wildlife are variable depending on the intensity and duration of the noise, as well as the auditory range of the animal itself. A study of wintering bald eagles found that human activities such as boating and fishing disturb eagles (especially adults). Normally occurring sounds were not particularly disturbing, although acute noise (such as gunshots) elicited escape behavior (Stalmaster and Newman 1978). Another study of bald eagles found human pedestrian activity was more disturbing than overflights by aircraft (Grubb and King 1991). At a study (Burger and Gochfeld 1998) conducted on a national wildlife refuge in Florida, researchers found that waterbirds such as the sora rail, glossy ibis, little blue heron and Louisiana heron were disturbed by the presence of visitors and that loudness was as significant of a disturbance as the number of people in this effect.

Highway noise has varied impacts, depending on species, tolerance to disturbance, and species preference. A study of impact of highways measured forest breeding birds in transects extending 1,200 feet (400 meters) from the edge of I-95 in Maine and found that four species were less abundant near the road while another six became more abundant near the roadway (Ferris 1979). Species that became less abundant near the road include the bay-breasted warbler, blue jay, Blackburnian warblers, and winter wrens. The six species that became more abundant near the road included the chestnut sided warbler, white-throated sparrow, wood thrush, common yellowthroat, robin, and Tennessee warbler.

Noise impacts can influence amphibians as well. The vocalizations of closely related anuran species, or even local populations of those with disjunctive distributions, are known to differ in frequencies, harmonics, duration and rate of repetition of individual calls, as well as trill or pulsation rates (Bogert 1960). Decibels (dB) are routinely used as a measure of sound intensity. Griffin and Hopkins (1974) measured sound levels of bullfrog (*Rana catesbeiana*) choruses and noted that the sound of calls travels unpredictably across a site depending on landscape and other ambient sounds. To be effective, the sound serving as the stimulus (i.e. frog calls) probably must be within relatively narrow limits of variation to be identified by that individual species (Bogert 1960). As documented

in these studies, some amphibian calls occur within a narrow frequency bandwidth. In relation to the refuge, calls at these lower decibel ranges may easily be overpowered by ambient noise, depending on the location within the refuge, based on the existing average DNL of 50 dB measured near Lindberg Boulevard. As such, noise associated with I-95 and the airport likely prevents effective communication by impeding these calls because the dB levels overlap with the dB levels of the amphibian calls.

Road noise has been documented to adversely impact amphibians. For instance, when exposed to motorcycle sounds up to 95 dB, estivating spadefoot toads (*Scaphiopus couchi*) responded by emerging from their burrows (Brattstrom and Bondello 1983). Emerging prematurely may cause stress on the toads because estivation has exacerbated dehydration and depleted energy reserves. While this species is not located on the refuge, the research implications provide concern for the less-researched amphibian species found on the refuge. If intense sounds, such as low-altitude aircraft, cause the toads in the refuge to emerge at a time when food and water are not available, chances are likely they will not survive, let alone be able to reproduce.

Even though the refuge is an undeveloped area within a highly urbanized landscape, some elements of the natural landscape are maintained. Emerging science on natural soundscapes shows the importance of recognizing and documenting local, natural soundscapes. These soundscapes are considered to be an essential part of a landscape, its representative and “vocal” wildlife, and one’s personal experience in the wild, whether in a park, wilderness, refuge, or similar form of natural landscape. As with other regions in North America, natural soundscapes have suffered greatly, mostly within the last 20 years. There are two main contributors to these changes: habitat destruction and an increase in human noise due to aircraft and land-based machinery, the impact of which is observed miles from the source (Krause 1999). There is no specific information on the soundscape of John Heinz NWR but there are clearly the sounds and noises of an urbanized landscape, in addition to the natural sounds normally associated with refuges. Traffic, airplanes, heavy equipment operation, industrial and commercial operations, and building and road construction all contribute to community noise and disturbance in varying degrees. These disturbances can be a feature of a degraded environment, and impacts due to human-induced noise need to be mitigated wherever possible.

3.9 Socioeconomic Landscape

Socioeconomic Setting of the Philadelphia Area and Refuge Surroundings

The refuge is located in southeastern Pennsylvania within Delaware and Philadelphia Counties. In 2010, the population of Delaware County was 558,979, an increase of 1.5 percent compared to 2000 (U.S. Census Bureau 2001, U.S. Census Bureau 2011a). The population of Philadelphia County was 1,526,006, an increased of 0.6 percent compared to 2000 (U.S. Census Bureau 2001, U.S. Census Bureau 2011a). This is compared to a 3.4 percent increase across the State of Pennsylvania and 9.7 percent for the country as a whole (U.S. Census Bureau 2011b). The average median household income in Delaware County between 2006 and 2010 was \$61,876, for Philadelphia County it was \$36,251 (U.S. Census Bureau 2011c). Average median household income for the same time was \$50,398 for the State and \$51,914 for the U.S. overall (U.S. Census Bureau 2011c). For 2011, unemployment was estimated at 8.0 percent in Delaware County, 10.8 percent in Philadelphia County, and 7.9 percent for the State of Pennsylvania (U.S. Department of Labor 2012).

According to the Delaware Valley Regional Planning Commission, 6 percent of the region’s population is 5 years old or younger; 22 percent is between 5 and

19 years; 59 percent is between 20 and 64 years; and 13 percent is considered elderly, age 65 and older. One of the greatest challenges facing the region in coming years will be the continued aging of the population, particularly in the suburbs, as nearly 9 percent of the population is between the ages of 55 and 64 years (considered “near elderly”). In particular, many of the neighborhoods immediately adjacent to the refuge are estimated to have over 15 percent of their residents 65 years or older (DVRPC 2009).

The surrounding landscape is demographically diverse. The percentage of the non-white or Hispanic population in surrounding neighborhoods ranges from less than 8 to over 30 percent. The average household income ranges from \$27,000 to 51,800 in surrounding portions of Philadelphia County and \$27,000 to 63,300 in neighboring portions of Delaware County. Single parents with children under 17 years of age comprise over 10 percent of households in most surrounding neighborhoods. From a transportation perspective, some neighboring communities in Philadelphia County have up to 47 percent of carless households—relying solely on public transportation or other means of transportation. While in surrounding Delaware County, carless households range from 8 to 30 percent (DVRPC 2009).

Population trends forecasted for Philadelphia over the period between 2000 and 2020 anticipate a slight loss in overall population. The surrounding population will continue to have a large percent of elderly residents, with some areas forecasted to have over 15 percent of its population be 65 years or older (DVRPC 2009). Minority populations in the region will continue to increase. Philadelphia is a “majority-minority” city, with 61 percent of its population being of minority race and/or Hispanic as of 2006. The percentage of minorities increased in every county in the region between 2000 and 2006, with 2006 percentages in the region’s suburban counties ranging from 36 percent in Camden County to 11 percent in Bucks County. Much of this growth in the minority population is attributable to growth in the numbers of Asians and Hispanics (DVRPC 2009).

Refuge Contribution to the Local Economy

The economic contribution of the refuge was evaluated as part of a nationwide survey and analysis conducted in 2006. In that year, the refuge recorded 106,491 visits. Ninety-eight percent of visits were for non-consumptive purposes such as hiking, wildlife observation, and photography. The majority of the visits (approximately 72 percent) were by nearby residents.

Total visitor expenditures related to recreation on the refuge estimated a total of about \$1.1 million in fiscal year 2006. Non-residents spent 67 percent of all visitor expenditures (about \$719,500). Based on the analysis conducted by the evaluation final demand associated with refuge visitor recreational spending totaled \$1.7 million. This represents the total dollars generated to the local economy as the result of refuge visits. This demand resulted in 14 jobs, which generated \$536,300 in income and \$241,400 in tax revenue. Non-resident visitors generated \$1.1 million in economic stimulus to the local economy (Carver and Caudell 2007).

In context, the 36 million visitors to the Greater Philadelphia area spent \$5 billion in 2009 (Tourism Economics 2009). Tourism is a significant part of the economy in the region and 83,664 jobs were sustained by visitors in 2009 with a total income of \$2.6 billion (GPTMC 2010). The Greater Philadelphia Tourism Marketing Corporation estimates that tourism generated \$1.2 billion in taxes in 2009 and that 5 percent of all jobs in the region are sustained by tourism.

3.10 Refuge Administration

Staffing

John Heinz NWR is managed by staff dedicated specifically to the refuge and its programs. This refuge currently has ten permanent staff: a refuge manager, deputy refuge manager, refuge wildlife biologist, a supervisory park ranger, one park ranger/law enforcement officer, a park ranger (visitor services), two outdoor recreation planners, facilities manager, and a maintenance worker. Seasonal staff positions, including a temporary biological technician, currently vary between one and five each year.

Budget

Operational funding includes salaries, supplies, utilities, fuel, and all other operational activities (wildlife and habitat surveys and management) that are not funded by special projects. Base maintenance funds, used to repair vehicles, equipment, and facilities, generally have been stable over the past 5 years. The replacement of vehicles, larger pieces of equipment (e.g., tractor, backhoe), or larger facilities (buildings) are funded as projects.

Our annual funding fluctuates according to the number and size of special projects funded that year (e.g., vehicle or equipment replacement, visitor service enhancements, and facility improvements). In 2010, the refuge operated on a budget of approximately \$1.2 million. This level of funding is relatively consistent with prior years: \$1.1 million in 2008, \$1.3 million in 2009.

Acquisition

Map 1.3 depicts the refuge ownership boundary as of April 2012. Table 3.2 below summarizes the land acquisition history of the refuge by year. The refuge currently owns 993 acres within its 1,200-acre approved acquisition boundary. There are eight existing right-of-way easements for pipeline, utility, and transportation infrastructure located within lands owned in fee by the refuge.

Table 3.2. Land Acquisition History of John Heinz NWR

Acquisition Date ¹	Funding Source	Acres
1910	MBCF ² , NONE	167.59
1973	NONE	145.33
1978	LWCF ³ , NONE	147.56
1979	LWCF, NONE	139.93
1980	LWCF, NONE	318.76
1986	OTHER	0.00
1995	NONE	18.30
1996	LWCF	55.70
	Total Acreage =	993.2

¹ While the refuge was not established until 1972, the U.S. Government had acquired some lands prior to that time. After 1972, these lands officially became part of the refuge.

² MBCF—Migratory Bird Conservation Fund.—the funding source is receipts from the sale of Federal Migratory Bird Hunting and Conservation Stamps.

³ LWCF—Land and Water Conservation Fund.—funding sources include revenues from the sale of surplus Federal real property, motorboat fuel taxes, fees for recreation on Federal lands, and receipts from mineral leases on the outer continental shelf.

Distributing Refuge Revenue Sharing Payments

Since 1935, the Service has made refuge revenue sharing payments to local municipalities containing lands under its administration. The actual amount of the payments is determined by formulas specified in the Revenue Sharing Act (16 U.S.C. 715s) and annual funding appropriated by Congress. The formulas used to determine payments to local municipalities are based on the number of acres in each municipality and the appraised value of refuge lands in their jurisdiction. Currently for John Heinz NWR, we make revenue sharing payments to Delaware County, the townships of Darby, Folcroft, and Tinicum, the Interboro School District, and the city of Philadelphia. Between fiscal years 2005 and 2009, combined payments to all municipalities have averaged about \$38,000 per year.

3.11 Refuge Natural Resources

John Heinz NWR is located within Philadelphia and Delaware Counties, about one-half mile north of Philadelphia International Airport (map 1.2). The freshwater tidal marsh at the refuge now comprises approximately 80 percent of the State's coastal wetland (Cohen and Johnson 2004, PNHP 2008). The refuge represents an important migratory stopover along the Atlantic Flyway that provides a mix of freshwater habitats. It also provides protected breeding habitat for State-listed threatened and endangered species, as well as many neotropical migrants (Cohen and Johnson 2004).

The refuge contains a variety of ecosystems unique within Pennsylvania and the Philadelphia metropolitan area including tidal and nontidal freshwater marsh, freshwater tidal creek, open impoundment waters, coastal plain and riparian forests, and early successional grasslands. Many of the refuge's ecosystems have been degraded, damaged, or (in some cases) destroyed as a result of the numerous anthropogenic impacts. However, many of these impacted ecosystems have the potential to be restored or enhanced through various management efforts. Some areas, including portions of the tidal marsh, contain healthy and intact ecological communities. Because of the refuge's location within the coastal plain (a small and unique physiographic region within Pennsylvania), many of its ecosystems contain unique plant communities or species of conservation concern.

Regional Conservation Context

Being situated within a highly urbanized landscape, the refuge is geographically isolated from many other conservation lands in the region (see map 1.2). The largest (over 1,000 acres) and closest natural areas near the refuge consist of freshwater tidal marsh located across the Delaware River in New Jersey (less than 5 miles away), as well as the forested habitats of Fairmount Park, Ridley Creek State Park, and Valley Forge National Historic Park (all within 25 miles of the refuge).

As a result, the refuge has limited biological connectivity to adjacent conservation lands. Aside from a single 100-acre parcel of forested land abutting the eastern refuge boundary, there is little other terrestrial habitat available directly outside of the refuge boundary. Aquatic resources remain connected between the tidal Darby Creek and the Delaware River. Nontidal portions of Darby Creek do contain several low-head dams impeding upstream movement of fish and limiting available spawning habitat.

The refuge is the only Federal conservation land located in Delaware and Philadelphia Counties. The nearest national wildlife refuge, Supawna Meadows NWR, is located approximately an hour's drive south of the refuge near Salem, New Jersey. The recently authorized Cherry Valley NWR will be located approximately a 1 to 2 hour's drive north the refuge.

3.12 Refuge Biological Resources

Natural Community Types

Refuge lands include a variety of ecosystems including open water, forests, grasslands, and tidal and nontidal wetlands. Many of the ecosystems (and the habitats they support) have been degraded, damaged, or destroyed as a result of the numerous impacts previously cited. Despite these alterations, many of these impacted ecosystems have the potential to be restored through various management actions and specific projects. Other areas, including portions of the freshwater tidal marsh, contain healthy and intact plant communities. Some ecosystems support plant communities or species of concern.

The Refuge System has adopted the National Vegetation Classification System developed by the Nature Conservancy and the Natural Heritage Network as a standard for classifying plant communities. The classification contains hierarchical levels of community specificity. The broader habitat categories that are comprised of these communities are displayed on map 3.1. The location and extent of the individual plant communities are displayed on map 3.2.

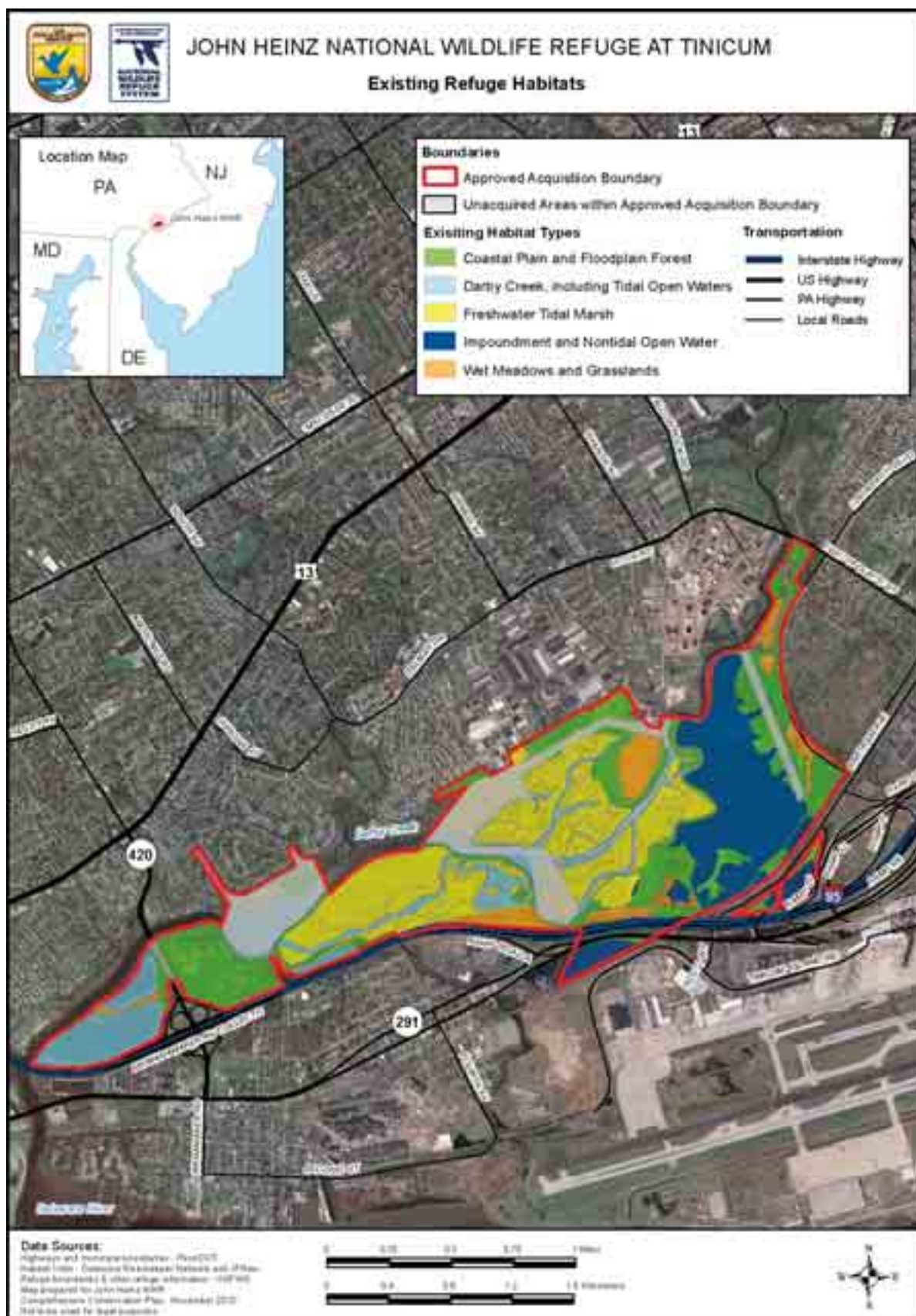


Bill Thompson/USFWS

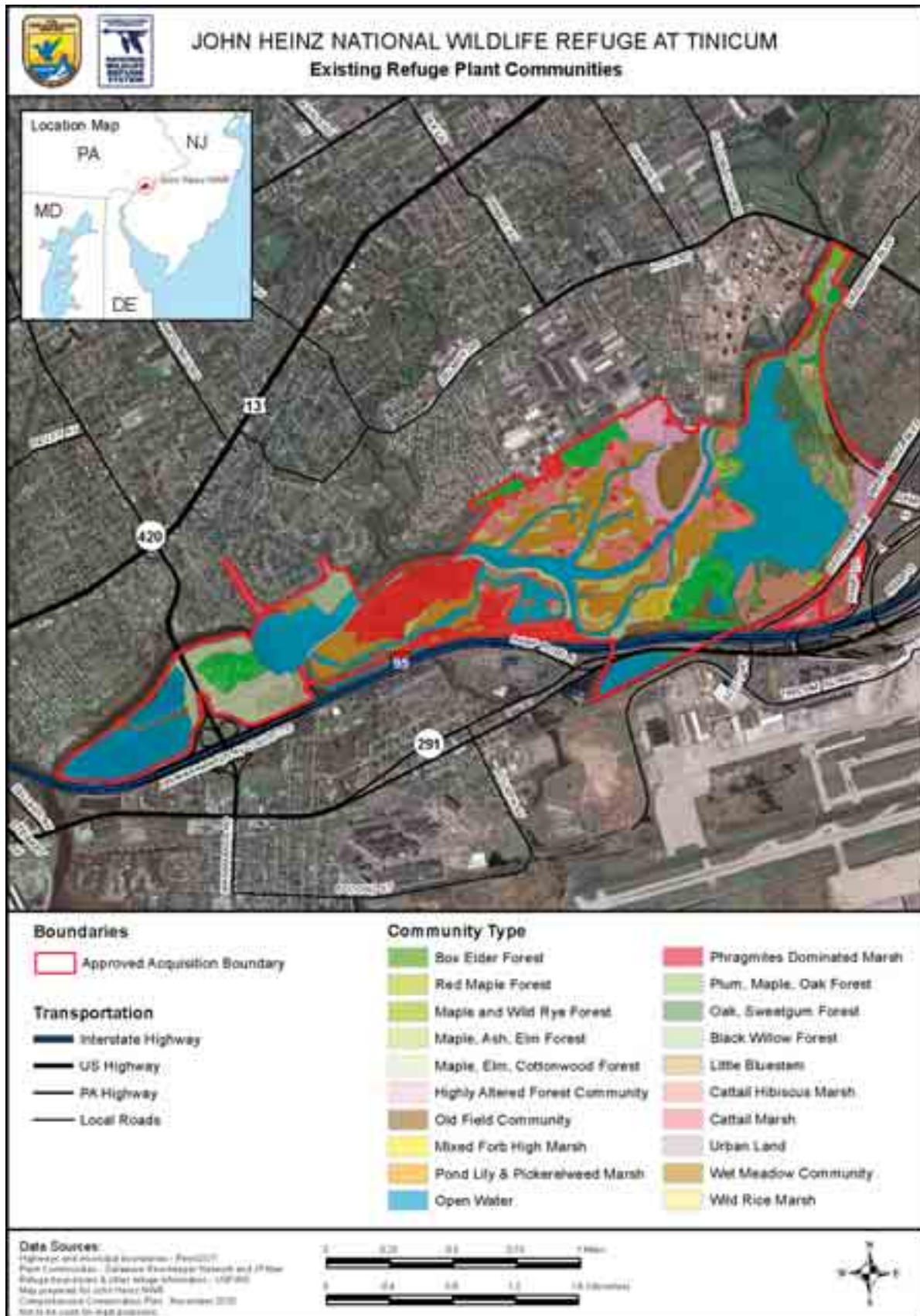
Bald eagle

Table 3.3 lists the National Vegetation Classification System Associations found within the various broad scale habitats of the refuge. Where possible, the conservation status rankings have been indicated as referenced by NatureServe Explorer and the Pennsylvania Natural Heritage Program. Conservation status rankings indicate how imperiled a species or community is on either a global, national, or state level. “S” identifies state rankings, where “G” designates global

Map 3.1. Habitats of John Heinz NWR



Map 3.2. Plant Communities of John Heinz NWR



rankings. A scale of 1 through 5 is applied to denote the conservation significance of a particular habitat on each scale. A 1 identifies the habitat as “critically imperiled,” a 3 indicates the habitat as “vulnerable,” while a rank of 5 notes an occurrence as “secure.”

Table 3.3. Broad Habitat Types and National Vegetation Classification System Associations and Alliances Found within John Heinz NWR

Broad Habitat Types	Natural Community Types	Conservation Ranking (Global¹; State²)
Freshwater Tidal Marsh	Atlantic Coast Wild Rice Tidal Marsh	G4; S1
	Freshwater Intertidal Mudflat	G3/G4; S1
	Freshwater Tidal Mixed Forbs High Marsh	GNR; S1
	Spadderdock Tidal Marsh	GNR; SNR
	Arrowhead – Pickerelweed Tidal Herbaceous Vegetation	G3/G4; S1
	Phragmites Dominated Marsh	GNR; SNR
	Cattail – Bulrush Eastern Herbaceous Vegetation	G5; SNR
Freshwater Nontidal Wetlands	Phragmites Dominated Marsh	GNR; SNR
	Narrow-leaved Cattail – Swamp Rose Mallow Herbaceous Vegetation	GNR; SNR
Open Water	Freshwater Intertidal Mudflat	G3; S1
Coastal Plain Forest	Pin oak – Swamp White Oak – Sweetgum Mixed Hardwood Forest	G3; S2
Floodplain Forest	Boxelder Forest	GNR; SNR
	Red Maple Forest	GNR; SNR
	Silver Maple - Boxelder / Virginia Wild Rye Forest	G4; SNR
	Maple (Red, Silver) – Ash – American Elm Forest	G4; S1
	Silver Maple – American Elm – (Cottonwood) Forest	G4; S3
	Black Willow Temporarily Flooded Shrubland	GNR; SNR
	Black Cherry – Red Maple – Serviceberry – Oak Forest Alliance	GNR; SNR

¹NatureServe Global Conservation Status Rankings: G1=Critically Imperiled; G2=Imperiled; G3=Vulnerable; G4=Apparently Secure; G5=Secure; GNR=Not Ranked; GU=Unknown; GX=Presumed Extinct; GH=Possibly Extinct

²NatureServe State Conservation Status Rankings: S1=Critically Imperiled; S2=Imperiled; S3=Vulnerable; S4=Apparently Secure; S5=Secure; SNR=Not Ranked; SU=Unknown; SX=Presumed Extinct; SH=Possibly Extinct; SNA=Not Applicable

Freshwater Tidal Wetlands

Freshwater tidal wetlands comprise approximately one-third of the refuge. Protection of this habitat is one of the primary purposes outlined in the refuge’s mandated purposes. The marsh contains some ecological communities considered State critically imperiled (S1) and globally rare (G3) and occurrences of State/federally rare, threatened, and endangered plant and animal species

(NatureServe 2005, PNHP 2008). These wetlands are subject to a range of tidal fluctuation on a daily basis of approximately 6 feet between mean high tide and mean low tide. Vegetation is diverse, with species and plant communities directly influenced by the relative elevation of mean high tide.

Most freshwater tidal marsh is dominated by pickerelweed, arrowhead, spatterdock, or wild rice. However, the PADCNr notes that portions of this marsh support several State rare species such as waterhemp ragweed (*Amaranthus cannabinus*), field dodder (*Cuscuta pentagona*), Walter's barnyard-grass (*Echinochloa walteri*), an un-named eupatorium (*Eupatorium rotundifolium*), forked rush (*Juncus dichotomus*), and shrubby camphor-weed (*Pluchea odorata*) (VanDervort-Sneed personal communication 2010).

Coastal Plain and Floodplain Forests

Coastal plain and floodplain forests are the habitat type that is considered to be the late-successional forest community typical of the Pennsylvania Coastal Plain region. Coastal plain and floodplain forests provide important habitat for migrating passerine species. The Atlantic Coastal Plain in Pennsylvania was historically found only in a 1 to 5 milewide strip along the lower 50 miles of the State's Delaware River frontage. The coastal plain and floodplain forest types covered a significant portion of Philadelphia, supporting a suite of species common to forests further south (PNHP 2008).

Coastal plain forests are noted as a rare habitat type within Pennsylvania (PNHP 2008). These forests are dominated by a canopy mix of oak and sweetgum. Under reference conditions, oaks should typically comprise at least 25 percent of the dominance in a stand. Other typical canopy associates may dominate, including sweetgum, blackgum, and swamp white oak. Other wetland hardwood species can occur, including silver maple, river birch, and northern red oak. Native shrub and vine species are variable and may include dogwoods, spicebush, Virginia creeper, and elderberry (NatureServe 2005, Westervelt 2006).

Intactness of this forest type varies between stands; however, most are impacted by excessive deer browse and invasive species colonization. Garlic mustard, Japanese honeysuckle, and Japanese stiltgrass dominate much of the groundlayer while vines such as Oriental bittersweet are also frequent. Mile-a-minute vine is widespread in many canopy gaps and appears to be preventing canopy tree regeneration. Additional invasive species found within the canopy include Norway maple and tree-of-heaven. A portion of the floodplain forest located in the southeastern portion of the refuge is dominated by a hybridized, nonnative gray poplar (*Populus x canescens or alba*) (Salas et al. 2006), see "Highly Altered Habitats" later in this section for additional information.

Darby Creek

The tidal portion of Darby Creek and its side channels flows through the refuge and tidal marsh. Since this represents an aquatic habitat, the ranking system used for the terrestrial habitats does not apply. Despite a lack of ranking, Darby Creek is known to support a diversity of estuarine fish species described in more detail in the next section.

The geomorphology, water quality, and influences of Darby Creek are discussed in more detail in section 3.6 above.

Impoundment and Nontidal Open Waters

The refuge contains several small open water features and a managed impoundment (table 3.4).

Eastern box turtle

USFWS

Table 3.4. Summary of Existing Open Water Features at John Heinz NWR

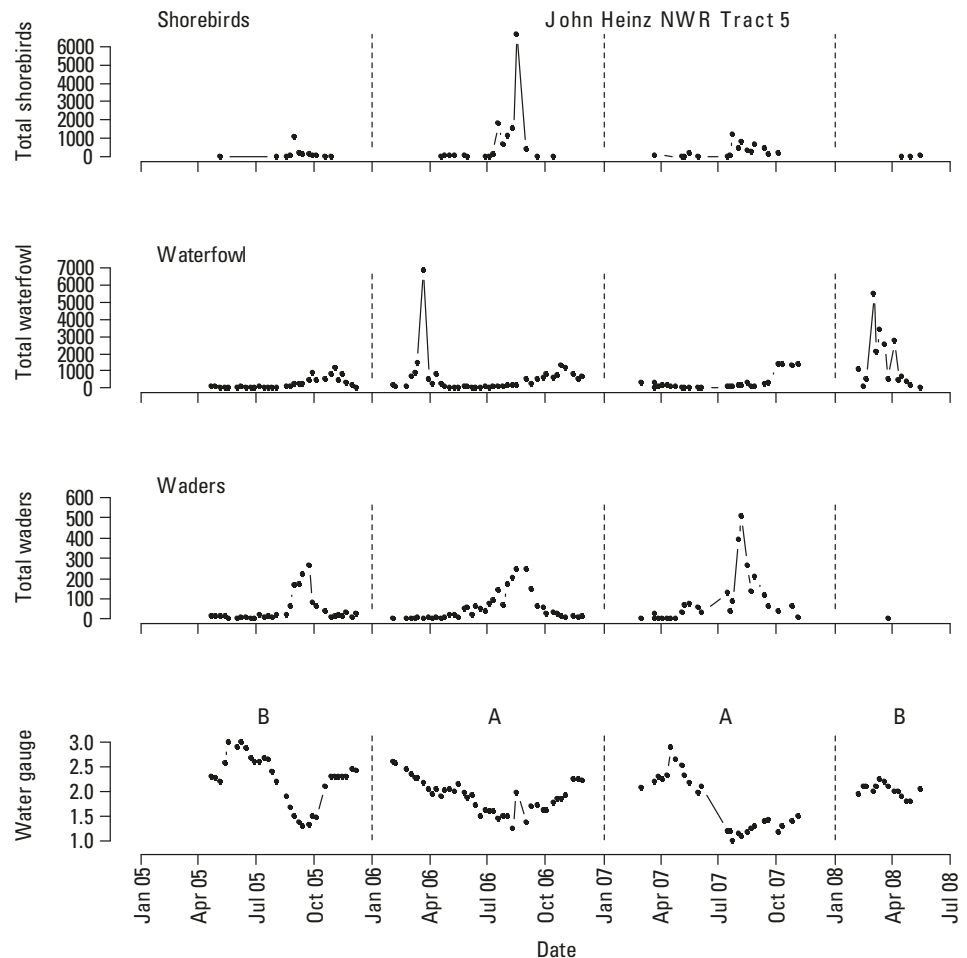
Name	Size (Acres)	Features
145-acre Impoundment	145	Managed impoundment for open water and mudflat.
Impoundment Fringe	34.1	Open water and marsh areas surrounding Impoundment.
Frog Pond	<0.5	Shallow water area near visitor center.
Hoys Pond	5	Deep water pond near I-95.
16-acre Pond	16	Open water bounded by Bartram Ave and I-95.

The 145-acre impoundment and nearby nontidal open water habitats of the refuge provide stopover habitat for a variety of waterbirds, waterfowl, and shorebirds. Over the past several years, the Service has managed the water levels within the impoundment to benefit migratory waterfowl, wading birds, and shorebirds with successful results (Green et al. 2008, Phillips personal communication 2008). This recent management was completed in conjunction with 23 other refuges across the Service's Regions 3 and 5 as part of a 3-year management experiment. Management prescriptions for the timing of water manipulation in impoundments involved drawdowns to coincide with either spring or fall shorebird migration. The effects of this timing on waterbird communities, invertebrate communities, and vegetation communities were monitored throughout the annual wetland cycle. In addition to evaluating the effects of traditional habitat management practices on attaining objectives for a suite of trust species, this study provides monitoring protocols, databases, and analytical methods that can be used by the refuges after the study ends for adaptive management of their impoundments (Lyons et al. 2005).

The recently completed impoundment study included timed drawdowns. These timed drawdowns focused on providing the optimal habitat available within the impoundment for various bird groups during their peak migration stopovers in both spring and fall (figure 3.3).

The two treatments noted were an early season drawdown timed to coincide with spring shorebird migration (Treatment A), and a late season drawdown coinciding with summer/fall shorebird migration (Treatment B). Timing of each treatment (as displayed above) includes 2005, Treatment B; 2006–2007, Treatment A; 2008, Treatment B. Dashed vertical lines indicate the beginning of a year.

Figure 3.3. Shorebird, Waterfowl, and Wader Abundance (adjusted for partial observability) and Water Gauge Levels within the 145-acre impoundment at John Heinz NWR (from Green et al. 2008)



It appears that the timed management developed as part of the study has been successful in supporting diverse bird population use of the impoundment area (Green et al. 2008; Phillips personal communication 2008). Based on the draft results of this study, variations in mean water levels and vegetation composition provide the most benefits for migrating groups are presented in table 3.5.

Table 3.5. Bird Groups and Optimal Conditions for Migratory Stopover and Forage Enhancement Within the Impoundment (based on results of the R3/5 Impoundment Study)

Bird Groups	Water Depth (inches)	Vegetation Composition and Areal Coverage	Time of Year
Shorebirds	0.0 to 6.0	Mudflats containing less than 10 percent vegetative cover.	Spring: May Fall: Mid-August to September
Waterfowl	6.0 to 24.0	less than 10 percent cover of shallow marsh and emergent aquatic species (including <i>Carex</i> , <i>Polygonum</i> , and <i>Peltandra</i>)	Spring: Late March Fall: Late October
Wading Birds	6.0 to 12.0	Open water containing less than 10 percent vegetative cover.	Spring: Late March Fall: Late August

Portions of the impoundment also contain numerous nesting boxes. These boxes (primarily for swallow, but also for wood ducks) have been installed and maintained by a combination of refuge staff and volunteers. These boxes were initially installed to provide opportunities for wildlife observation and interpretation, including how visitors can benefit wildlife in their own backyard.

The impoundment and open waters also provide support for reptile and landbird breeding habitat. Bald eagles have nested successfully in forested areas adjacent to the impoundment. The impoundment area also provides secondary habitat for the State-listed southern leopard frog and breeding, feeding, and hibernation habitat for the State-listed eastern redbelly turtle (*Pseudemys rubriventris*) (Stolz personal communication 2005). Management considerations must be made to sustain the use by and protection of these non-bird focal species as well.

There are several impediments to effectively managing the 145-acre impoundment. The mean bed surface of the impoundment is approximately 1 foot below that of the mean low flow elevation of Darby Creek. Additionally, the impoundment receives uncontrolled stormwater from neighboring lands in which is a source of pollution and added water volume during rain events. Increasingly, the impoundment also becomes flooded out during high flow events resulting from more frequent and extreme precipitation. These excessive water levels have breached or caused substantial damage to the dike and access road system around the impoundment on at least four occasions over the past 10 years (Stolz personal communication 2010).

Another issue with impoundment management is ongoing maintenance of the dike and access road along the north and western edge of the impoundment. Burrowing mammals may potentially excavate small holes and tunnels into the sides of dike roads. These burrows can lead to dike weakening and collapse over time if unaddressed. To minimize or repair the damage from burrowing mammals, the refuge occasionally adds stone rip rap or fill to portions of dikes washed out by high water. To date, burrowing has not resulted in any major dike failures, however refuge staff continue to evaluate the potential for this management concern.

The remaining 56 acres of nontidal open waters owned by the refuge include a series of deeper ponds near or adjacent to I-95. Hoy's Pond is a 5-acre pond with maximum depths between 6 and 10 feet. The water is relatively clear with large mats of duckweed (*Lemna* spp.) covering much of the water surface around the edge of the pond. Hoy's Pond is a popular fishing site, where anglers pursue largemouth bass (*Micropterus salmoides*) and sunfish (*Lepomis* spp.) species. In

the past, refuge staff has added recycled Christmas trees to the pond to serve as cover for fish species.

Another open water habitat area is known as 16-acre pond. It is located along Route 291 and Bartram Avenue. It is shallow with depths generally less than 3 or 4 feet with some spatterdock coverage. This pond receives stormwater inputs from surrounding industrial and commercial lands. Its location between several roads and highways with heavy traffic makes it not only biologically isolated, but also difficult to access for management. As a result of low habitat values and isolation from other nearby waters (Sweka and Mohler 2010), we do not actively manage the 16-acre pond. The water of 16-acre pond is highly eutrophic (Sweka and Mohler 2010). This pond contains a mix of common, pollution-tolerant, warm-water fish species such as bluegill.

Grasslands and Wet Meadows

Grasslands and native meadows likely covered a substantial proportion of the Philadelphia area prior to European colonization. It is unlikely that these were self-sustaining ecosystems in this area. There is extensive evidence that meadows were managed by resident Native Americans who burned them on a periodic basis to prevent their succession back to forest and provide foraging areas for game species such as grouse, turkey, deer, and elk (Latham et al. 2005). These systems supported plant species that are generally common to the extensive grasslands found in Midwestern States despite their diminutive size. As availability of grassland habitats has decreased, these species have experienced population declines and are now considered among the most threatened species within the Mid-Atlantic region (PIF 1999). Several remnant native meadows exist within Philadelphia with active restoration plans. Active management of these areas typically includes the removal of nonnative invasive species, replanting of lost native species, and control of woody species (PNHP 2008).

Prior to the 1990s, John Heinz NWR had a substantially greater amount of grasslands than today (McCormick et al. 1970, McMenamin personal communication 2008). Currently, many of these historic grasslands are covered by coastal plain or floodplain forest community types. The Restoration Management Plan for Lower Darby Creek compared habitat coverage between those documented in the two studies of Tinicum Marsh (McCormick et al. 1970) and those identified as part of field inventories conducted in 2005 (Salas et al. 2006). Many forested areas along the existing dike system and within areas east and south of the 145-acre impoundment contained scattered trees (less than 10 percent cover) and “old field” vegetation in 1968, making the forested habitats of the refuge a relatively recent cover type. Additionally, historic aerial photographs reviewed as part of that plan documented a greater extent of grasslands east of the existing impoundment (Salas et al. 2006). Due to this relatively isolated and small (less than 100 acres) component of grassland, it is unlikely that the refuge ever had significant regional populations of priority grassland birds.

Several meadow and grassland communities at the refuge provide habitat for resident, as well as stopover habitat for migrating songbirds and raptors amphibians, reptiles, and mammal species. These grasslands provide important habitat for focal species of concern such as the short-eared owl, sedge wren, marsh wren, and the southern leopard frog. The southern leopard frog in particular is known to breed in some of the shallow permanent water and vernal pool habitats found within the refuge’s wet meadow grasslands (Phillips and McMenamin personal communication 2008).

Most of the grasslands existing on the refuge today are the result of managed utility right-of-ways that intersect portions of the refuge. Utility corridors transporting oil, gas, potable water, wastewater, and electricity all pass through the refuge. Due to the disturbed nature of these communities, none contain the

species composition to make them identifiable with known grassland associations by the National Vegetation Classification System.

Highly Altered Habitats

In addition to the naturally occurring communities located within the refuge, there are several highly altered communities present. Highly altered forests of John Heinz NWR consist of existing forested habitats that have either not been completely inventoried to understand and delineate their National Vegetation Classification System community types due to access restrictions or contain substantial variation from natural forest communities typical of the refuge and surrounding region. Despite their alteration, these habitats can still provide significant ecological value and quality habitat. The 145-acre impoundment already discussed provides significant value to migratory and overwintering waterfowl and shorebirds. Additionally, altered grasslands, forests, and wetlands provide diversity of habitat types and a unique set of ecological services that benefit both wildlife and visitors to the refuge.

Federally Listed Species

The refuge does not support any known federally listed threatened or endangered species. The refuge does provide potential foraging and nursery habitat for the federally listed, endangered shortnose sturgeon (*Acipenser brevirostrum*). This species is known to occur in the nearby Delaware River. However, this species has not been identified within Darby Creek or on the refuge to date.

State-listed Species

The refuge does support a number of State-listed threatened or endangered plants and animals. State-endangered birds such as the American bittern, least bittern, black crowned night heron, king rail, great egret, yellow-crowned night heron, and sedge wren all forage and/or breed on the refuge. The same is true for State-threatened species such as the bald eagle. The State-endangered southern leopard frog is known to breed in shallow wetlands found within refuge forests and grasslands. The State-threatened eastern redbelly turtle is also known to breed on the refuge as well.

Rare Plant Species and Exemplary Natural Communities

John Heinz NWR protects the last significant remnant of freshwater tidal marsh within the State of Pennsylvania. Several of the natural communities within the freshwater tidal marsh are ranked as S1—critically imperiled within the State (typically five or fewer occurrences or very few remaining individuals or acres), or S3—vulnerable in the State either because they are rare and uncommon, or found only in a restricted range, or because of other factors making them vulnerable to extirpation (typically 21 to 100 occurrences). The forested habitats of the refuge also contain communities of significant conservation status. Several coastal plain and floodplain forest communities identified on the refuge are ranked as S1 (critically imperiled), S2 (imperiled), or S3 (vulnerable).

Wildlife

John Heinz NWR was established in 1972 for the purpose of preserving, restoring, and developing the natural area known as Tinicum Marsh, to promote environmental education, and to afford visitors an opportunity to study wildlife in its natural habitat. The diverse habitats support a variety of resident and migratory wildlife including 300 species of birds recorded since 1950, as well as many mammals, fish, amphibians, reptiles, insects, and plants. Refer to appendix A for the refuge's comprehensive list of species of conservation concern.

Birds

The refuge is a complex of critical habitats for birds in the highly urbanized landscape of greater Philadelphia. It has been designated as an Important Bird Area by the National Audubon Society. While most of the 300 plus avian species identified at the refuge utilize it as a migratory stopover, more than 80 species have been recorded nesting on the refuge over the years. Several species are also State-listed threatened or endangered species or species of State or national management concern.

The periodic drawing down of the impoundment and the presence of tidal mud flats provide some of the best stopover habitat for migrating shorebirds in Pennsylvania (Cohen and Johnson 2004). In addition, many waterfowl, wading birds, waterbirds, and landbirds utilize the impoundment. The area serves as a wintering ground for over 20 species of waterfowl with 1,100 to 1,400 individuals observed per day between September and March (Green et al. 2008).

State endangered species such as the least bittern (*Ixobrychus exilis*) are known to breed at the refuge. Other Pennsylvania endangered species that have been observed at the site during migration, but are considered occasional or rare in abundance, include: yellow-crowned night-heron (*Nyctanassa violacea*), common tern (*Sterna hirundo*), black tern (*Chlidonias niger*), king rail (*Rallus elegans*), short-eared owl (*Asio flammeus*) and loggerhead shrike (*Lanius ludovicianus*). The king rail historically nested at the site (prior to 2000). The piping plover (*Charadrius melodus*) listed as extirpated in Pennsylvania, is an occasional “accidental” occurrence during migration.

Bald eagles (*Haliaeetus leucocephalus*), a former federally listed endangered species that has recovered and been delisted, have historically utilized the refuge for hunting and roosting. The first known bald eagle nest on the refuge was built in 2009 with the first two refuge eaglets successfully hatched in 2010. The pair returned to breed on the refuge in 2012.

The peregrine falcon (*Falco peregrinus*), another former federally listed, endangered species that has recovered and become federally delisted, is often observed from the refuge during its migration. A number of active peregrine nests now occur in the Philadelphia area with these birds also potentially increasing their use of refuge habitats (Cohen and Johnson 2004).

The State-listed, threatened species, upland sandpiper (*Bartramia longicauda*) and yellow-bellied flycatcher (*Empidonax flaviventris*), have been observed at the site, but are considered rare or occasional in abundance, observed primarily during the migratory season. Osprey (*Pandion haliaetus*) is present during migration and is frequently observed throughout summer. Two osprey platforms have been added to the refuge in hopes to lure in nesting birds. State species of special concern that use the refuge are the black-crowned night-heron (*Nycticorax nycticorax*) and northern harrier (*Circus cyaneus*). The black-crowned night-heron nested (52 nests reported) at the site prior to 1996 but are now considered transient. Northern harrier is observed less frequently at the site since grassland buffer habitat has disappeared due to habitat successional changes and development. The green-winged teal (*Anas crecca*) and marsh wren (*Cistothorus palustris*) are State rare species that nest at the refuge. The pied-billed grebe (*Podilymbus podiceps*), American coot (*Fulica americana*), Wilson’s snipe (*Gallinago delicata*), Swainson’s thrush (*Catharus ustulatus*), prothonotary warbler (*Protonotaria citrea*) and summer tanager (*Piranga rubra*) are other State candidate-rare species that have been observed at the refuge as well (Cohen and Johnson 2004).

The refuge also provides habitat for occasional visits from species outside of their standard range. Recently in July 2011, the refuge confirmed its first occurrence of an immature white ibis (*Eudocimus albus*) foraging on the refuge. White ibis has been reported as a rare visitor to Pennsylvania (Audubon 1843), and New Jersey (Turnbull 1869) since the 19th century. The last sighting of this species occurred during the summer of 1980 (Miller 1982, 1988, Paxton et al. 1981).

Mammals

John Heinz NWR is 1 of 44 Important Mammal Areas designated by the Pennsylvania Wildlife Federation. The designation was awarded noting the refuge as supporting northern river otter use on occasion and being the last potential location for the marsh rice rat (*Oryzomys palustris*) in the State.

While no formal inventories have been conducted to date, numerous mammals are known to inhabit the refuge. Two nonnative species present include the Norway rat (*Rattus norvegicus*) and house mouse (*Mus musculus*). The gray squirrel (*Sciurus carolinensis*) is a common species found throughout upland habitats of the refuge, where it plays an important role in seed dispersal. Other common open space species supported by the refuge include the northern short-tailed shrew (*Blarina brevicauda*), the meadow vole (*Microtus pennsylvanicus*), white-footed mouse (*Peromyscus leucopus*) and several other rodent species, as well as raccoons (*Procyon lotor*), mink (*Mustela vison*), skunks (*Mephitis mephitis*), opossums (*Didelphis virginiana*), and eastern cottontail rabbit (*Sylvilagus floridanus*) (PNHP 2008). Woodchuck (*Marmota monax*) and red fox (*Vulpes vulpes*) have been observed damaging the impoundment levee system as they attempt to burrow dens into dikes (Stolz personal communication 2008). Feral domestic house cats pose a serious invasive mammalian predatory threat to all small native wildlife (birds, mammals, reptiles and amphibians) and need to be removed from the refuge when found.

Muskrat (*Ondatra zibethica*), long-tailed weasel (*Mustela frenata*), and least shrew (*Cryptotis parva*) are fairly common. Recent records also indicate beaver (*Castor canadensis*) and river otter (*Lontra canadensis*) occur occasionally on the refuge. It is also likely that the refuge sees occasional use by coyote, which have been documented on adjacent property at Philadelphia International Airport (Stolz personal communication 2008). Bats are frequently observed on the refuge during warmer seasons and a formal species diversity and population survey would provide valuable information on recent declines of these important creatures due to white nose syndrome and habitat disturbances.

White-tailed deer (*Odocoileus virginianus*) are another mammal supported by the refuge. Refuge staff has conducted on-the-ground deer population surveys for several years. These surveys have been conducted by counting deer driven systematically from various portions of the refuge. Several different types of surveys were conducted in development of the refuge's deer management plan (D'Angelo 2012). Between 2001 and 2010, deer density estimates ranged from 57 to 163 deer per square mile based upon standardized deer drives conducted by refuge staff and volunteers. While standardized, this type of survey does have the potential to double-count individuals. Between 2008 and 2011, the refuge also conducted forward looking infrared (FLiR) surveys, which reduce the likelihood of double-counting. According to these surveys, deer densities were between 57 and 83 deer per square mile.

Frozen marsh at
John Heinz National
Wildlife Refuge
at Tinicum



Larry Woodward/USFWS

Density levels at which a deer population is considered “ecologically sustainable” varies depending on the habitat involved and the variables studied. A separate deer and songbird population relationship study in northwestern Pennsylvania concluded that the threshold level for negative effects on songbird richness was between 20 and 38 deer per square mile (deCalesta 1994). Additional research has shown a population density not exceeding 20 deer per square mile is optimal for forest regeneration (Rooney 2001).

As noted, refuge staff estimate that the current deer population utilizing the refuge far exceeds this density. It is reasonable to assume, therefore, that these adverse effects on vegetation are present. Some of these effects were noted in vegetative surveys previously conducted on the refuge (Salas et al. 2006). More current surveys (D’Angelo 2012) also document these impacts. Oak and maple saplings were present within fenced deer exclosures, while similar vegetation outside of the exclosures was browsed to the ground. D’Angelo also noted that invasive plants, which are often consumed to a lesser extent by deer, have become dominate vegetation types on many portions of the refuge. While such impacts affect current forest understory and wildlife dependent on this vegetation, the long term implications are that the refuge’s native forested areas could lose the ability to replace themselves through time (D’Angelo 2011).

The Service and the USDA Division of Wildlife Services have drafted a deer management plan. Once finalized, this plan will provide detailed guidance on management of the resident deer population based on observable impacts to (and recovery of) the refuge’s habitats, not on a particular density target (D’Angelo personal communication 2009).

Reptiles and Amphibians

While no formal inventories have been conducted, there are eight turtle, three snake, and eight frog and toad species known to inhabit the refuge. Common frog and toad species such as bull frog (*Rana catesbeiana*), green frog (*Rana clamitans melanota*), wood frog (*Rana sylvatica*), pickerel frog (*Rana palustris*), spring peeper (*Pseudacris crucifer*), American toad (*Bufo americanus*), and Fowler’s toad (*Bufo woodhousei fowleri*) have all been heard calling during their respective breeding seasons. The State-endangered species, southern leopard frog (*Lithobates sphenoccephalus utricularius*), is known to inhabit and breed at the refuge in shallow open water and isolated vernal pools.

The northern water snake (*Nerodia sipedon sipedon*), eastern garter snake (*Thamnophis sirtalis sirtalis*), and northern brown snake (*Storeria dekayi dekayi*) are all found at the refuge. These common species are generally associated with forested habitats or nearby open water.

Numerous turtles are known to use the open water habitats of the impoundment, freshwater tidal marsh, and Darby Creek. Species common to these habitats at the refuge include common musk turtle (*Sternotherus odoratus*), eastern box turtle (*Terrapene c. carolina*), painted turtle (*Chrysemys picta x marginata*), common map turtle (*Graptemys geographica*), eastern spiny softshell turtle (*Apalone spinifera*) and the nonnative, invasive red-eared slider (*Trachemys scripta elegans*) (USFWS 2009b). The refuge also supports several rare species of turtle such as the eastern mud turtle (*Kinosternon subrubrum*) (Urban personal communication 2012), the northern diamond-backed terrapin (*Malaclemys terrapin*), and a significant population of the State-threatened eastern redbelly turtle. These rare species are more commonly associated with the freshwater tidal marsh and open waters of Darby Creek. However, some of these have been known to move to and from the 145-acre impoundment as well.

Historically, the refuge and surrounding lands supported additional species of reptiles. The wood turtle (*Clemmys insculpta*) has been identified on lands

adjacent to the refuge (Sunoco tank farms). Although considered extirpated in Pennsylvania, a road kill gravid female eastern mud turtle was documented in nearby Bucks County in 2008. State surveys for the species were then conducted by East Stroudsburg State University including the refuge, and two small populations of eastern mud turtles were found in nearby Bucks County with continued hopes that they may still or in the future be rediscovered on the refuge (Stolz personal communication 2010).

A number of other reptile and amphibian species native to southeast Pennsylvania could potentially be discovered on the refuge where suitable habitat occurs within their native ranges. Such species include black rat snake, black racer, eastern ribbon snake, eastern milk snake, five-lined skink, eastern fence swift, gray tree frog, eastern chorus frog, red-backed salamander, long-tailed salamander, dusky salamander, red salamander and spotted salamander. Numerous nocturnal anuran vocalization surveys have been conducted as well as turtle mark-recapture studies with Drexel University and University of Philadelphia. At this time, a herpetological survey that includes terrestrial habitat and breeding areas to establish baseline data is necessary for long-term management of the refuge's reptile and amphibian fauna. Dr. Jim Spotila of Drexel University has indicated turtle nest predation on the refuge may be as high as 98 percent (most likely from raccoon, red fox, skunk and opossum) (Stolz personal communication 2009).

Fish

The refuge provides important aquatic habitat as well as terrestrial habitat. Freshwater tidal marshes, like Tinicum Marsh, are used by many aquatic species for spawning, year-round food and shelter, and as a nursery and rearing habitat (Mitch and Gosselink 1993). Freshwater tidal marshes are also a mixing zone for various groups of fish typically associated with certain habitats. Freshwater species, such as sunfish (*Lepomis spp.*) and catfish (*Ictalurus spp.*), estuarine species including killifishes (*Fundulus diaphanus*) and mummichogs (*Fundulus heteroclitus*), anadromous species including gizzard shad (*Dorosoma cepedianum*) and herrings (*Alosa spp.*), and the catadromous American eel (*Anguilla rostrata*) can all be found within Tinicum Marsh. A list of fish species observed on the refuge and in adjacent similar marsh areas around the Philadelphia International Airport can be found in table 3.6 (Herpetological Associates 2001a, NOAA 2000, Sweka and Mohler 2010, Stolz personal communication 2011).

Darby Creek and the open water areas of the freshwater tidal marsh may also provide suitable habitat for the Federal and State-endangered shortnose sturgeon (*Acipenser brevirostrum*) and Atlantic sturgeon (*Acipenser oxyrinchus*) (PNHP 2008, PGC and PFBC 2008). While this species has not been confirmed within the refuge itself, it is known to occur in the nearby Delaware River, thus making protection of suitable habitat within the refuge a priority.

In June 2011, refuge staff confirmed the first record of a bowfin (*Amia calva*), a Pennsylvania candidate rare species, within the refuge boundaries. The individual fish was caught during a refuge interpretive fishing event and released back into waters located on the refuge. Another sighting of this species also occurred adjacent to the refuge in 2010 near the Ridley Park Marina along Darby Creek (Stolz personal communication 2011). In 2012, a nonnative, invasive northern snakehead was captured by an angler on the refuge. While the refuge had received reports of snakeheads in the past, this was the first confirmed capture. Of even greater concern was the angler's account of behavior that indicated there could be additional adults and potential spawning behavior.

Table 3.6. Fish Species and Use of Lower Darby Creek and Freshwater Tidal Marsh Habitats (Herpetological Associates 2001a, NOAA 2000, Sweka and Mohler 2010, Stolz personal communication 2011)

Species		Habitat Use			
Scientific Name	Common Name	Spawning Area	Nursery Grounds	Shelter	Adult Forage
Freshwater Species					
<i>Ameiurus catus</i>	White catfish	~	~	~	~
<i>Ameiurus nebulosus</i>	Brown bullhead	~	~	~	~
<i>Amia calva</i>	Bowfin	~	~	~	~
<i>Catostomus commersoni</i>	White sucker	~	~		~
<i>Channa argus</i>	Northern snakehead	?	?	?	?
<i>Cyprinus carpio</i>	Common carp	~	~		~
<i>Etheostoma olmstedii</i>	Tessellated darter	~	~	~	~
<i>Gambusia affinis</i>	Eastern mosquitofish	~	~	~	~
<i>Hybognathus regius</i>	Eastern silvery minnow	~	~	~	~
<i>Ictalurus punctatus</i>	Channel catfish	~	~	~	~
<i>Lepomis cyanellus</i>	Green sunfish	~	~		~
<i>Lepomis gibbosus</i>	Pumpkinseed	~	~		~
<i>Lepomis macrochirus</i>	Bluegill	~	~		~
<i>Micropterus salmoides</i>	Largemouth bass	~	~		~
<i>Notemigonus crysoleucas</i>	Golden shiner	~	~	~	~
<i>Notropis hudsonius</i>	Spottail shiner	~	~	~	~
<i>Perca flavescens</i>	Yellow perch	~	~		~
<i>Pimephales notatus</i>	Bluntnose minnow	~	~		~
<i>Poxomis nigromaculatus</i>	Black crappie	~	~		~
<i>Umbra pygmaea</i>	Eastern mudminnow	~	~	~	~
Estuarine-Marine Species					
<i>Brevoortia tyrannus</i>	Atlantic menhaden				~
<i>Fundulus diaphanus</i>	Banded killifish	~	~	~	~
<i>Fundulus heteroclitus</i>	Mummichog	~	~	~	~
<i>Leiostomus xanthurus</i>	Spot	~	~		~
<i>Menedia beryllina</i>	Inland silversides	~	~	~	~
<i>Micropogonias undulatus</i>	Atlantic croaker	~	~		
<i>Trinectes maculatus</i>	Hogchocker		~	~	~

Species		Habitat Use			
Scientific Name	Common Name	Spawning Area	Nursery Grounds	Shelter	Adult Forage
Anadromous Species					
<i>Alosa aestivalis</i>	Blueback herring	~	~	~	
<i>Alosa mediocris</i>	Hickory shad	~	~	~	
<i>Alosa pseudoherangus</i>	Alewife	~	~	~	
<i>Dorosoma cepedianum</i>	Gizzard shad	~	~		~
<i>Morone saxatilis</i>	Striped bass		~		~
<i>Morone americana</i>	White perch	~	~		~
<i>Mugil cephalus</i>	Striped mullet		~		
Catadromous Species					
<i>Anguilla rostrata</i>	American eel		~	~	~

Invertebrates

While few invertebrate inventories have been conducted to date within the refuge or along Darby Creek, recent findings along the nearby Delaware River indicate that invertebrate conservation may be an added focus along Darby Creek. A series of mussel beds was identified in the stretch of river connected to the confluence with Darby Creek. Seven mussel species were identified within the Delaware River, including two species which were thought to be extinct in Pennsylvania and New Jersey: the alewife floater (*Anodonta imbecilis*), and the tidewater mucket (*Leptodea ochracea*). Other species included one species considered critically imperiled, the pond mussel (*Ligumia nasuta*), three species considered vulnerable: the creeper (*Strophitus undulatus*) yellow lampmussel (*Lampsilis cariosa*), and the eastern floater (*Pyganodon cataracta*) and one common species: the eastern elliptio (*Elliptio complana*).

Benthic macroinvertebrate sampling has been conducted upstream of the refuge in conjunction with water quality monitoring and characterization. No species of conservation concern were identified in those surveys. It is possible that crayfish species of conservation interest occur on the refuge including *Cambarus diogenes* and *C. acuminatus* (Urban personal communication 2012). Nonnative crayfish species may also occur on the refuge.

To our knowledge, no terrestrial invertebrate inventories have been conducted on the refuge to date.

Nonnative, Invasive Plants

Federal management of nonnative, invasive plant species is guided by the planning efforts outlined in Executive Order 13112 signed into law on February 3, 1999. This Executive Order requires that a Council of Departments dealing with invasive species be created and develop a National Invasive Species Management Plan every 2 years. The first such plan was released in January 2001, providing the basis for Federal management of invasive species. The Executive Order defines an invasive species as a species that is a) nonnative to the ecosystem under consideration and b) whose introduction causes (or is likely to cause) economic or environmental harm, or harm to human health.

The planning and inventory work completed as part of the Restoration Management Plan for the Lower Darby Creek in 2005 identified invasive plant species as one of the top impacts to refuge plant communities and a management priority for the coming years. The inventory identified nonnative invasive species

present throughout John Heinz NWR and ranked their management priority based on a) the extent to which the species is established on the refuge, b) the potential ecological impact of the species on refuge plant communities, and c) the degree of management difficulty involved in controlling the species. The results of this inventory and prioritization are included in table 3.7 (Salas et al. 2006). Management prescriptions for identified invasive species are included in the HMP included in appendix C.

Table 3.7. Invasive Species Identified at John Heinz NWR and Their Associated Management Ranking

Species	Ranking	Impact	Extent	Management Difficulty	Control Priority and Focus
Japanese knotweed <i>Polygonum cuspidatum</i>	1	●	○	●	High Prevent New Introductions and Eradicate Localized Occurrences
Porcelainberry <i>Ampelopsis brevipedunculata</i>	2	●	○	●	
Multiflora rose <i>Rosa multiflora</i>	3	●	○	●	
Reed canarygrass <i>Phalaris arundinacea</i>	4	●	○	●	
European privet <i>Ligustrum arvense</i>	5	○	○	○	
Common Reed <i>Phragmites australis</i>	6	●	●	●	
Purple Loosestrife <i>Lythrum salicaria</i>	7	●	●	●	
Mile-a-minute <i>Polygonum perfoliatum</i>	8	●	●	○	Medium Eradicate Localized Occurrences and Reduce Size of Existing Populations
Japanese honeysuckle <i>Lonicera japonica</i>	9	●	●	●	
Norway maple <i>Acer platanoides</i>	10	●	●	●	
Oriental bittersweet <i>Celastrus orbiculatus</i>	11	●	●	●	
Tree-of-heaven <i>Ailanthus altissima</i>	12	●	●	●	
Japanese hops <i>Humulus japonica</i>	13	●	●	●	Low Focus Primarily on Areas of Conservation Significance
Bush honeysuckle <i>Lonicera maackii</i>	14	●	●	●	
Japanese stiltgrass <i>Microstegium vimineum</i>	15	●	●	●	
Garlic mustard <i>Alliaria petiolata</i>	16	●	●	●	

● = High ● = Medium ○ = Low

3.13 Special Use Permits, Including Research

Special use permits are issued to individuals, organizations, and agencies that request the use of refuge facilities or resources beyond what is available to the public. To ensure that wildlife disturbance is minimized, special conditions and restrictions are analyzed individually for each request.

Currently, the refuge maintains several special use permits for various ongoing research utilizing the refuge:

- USDA, Animal and Plant Health Inspection Service is currently permitted to continue the ongoing research related to deer abundance and effects on refuge vegetation and habitats. This research will continue to inform refuge staff of the level of deer controls necessary to restore biological integrity and diversity to the refuge.
- The Academy of Natural Sciences and the Partnership for the Delaware Estuary are establishing long-term data collection sites to monitor sea level rise over the coming decades through the use of surface elevation tables. Surface elevation tables (SETs) and rod-SETs (rSETs) measure changes in marsh elevation at the millimeter scale, on an annual, and in some cases, seasonal basis. This level of precision is required to track very slow accretion or subsidence rates over time. SETs and rSETs can be used to determine a marsh's change in elevation due to a response to climate stressors such as sea level rise and/or non-climate stressors including management activities like burning and invasive species control.
- The Philadelphia Zoo has conducted annual and ongoing amphibian vocalization surveys throughout the spring breeding season. This research provides the refuge with species inventory and habitat use information for frog species across the refuge.

Ongoing Research and Monitoring Projects

Impoundment Management Study

In 2005 to 2007, John Heinz NWR participated in the Service Region 3 and Region 5 Impoundment Management Study. The goal of this study was to determine the effects of timed water level management related to use by waterfowl, shorebirds, and wading birds. This study found that waterfowl were observed throughout the year, while shorebirds and waders were observed primarily between April and October. Shorebird frequencies peaked around the spring and fall migration periods, and wader frequencies peaked in mid-summer. Shorebird species composition was dominated by peeps (semipalmated sandpiper, unidentified peep, least sandpiper) in both the spring (approximately 80 percent of all shorebirds observed) and fall (approximately 90 percent). Waterfowl species most abundant during the spring migration period were ducks. Four species (northern shoveler, green-winged teal, mallard, northern pintail) accounted for more than 70 percent of the waterfowl during that period. Species composition was similar during the fall, with mallards and gadwall accounting for 47 percent of the waterfowl seen. Canada geese became the second-most abundant species during this same period. Great egrets and great blue herons dominated the waders observed during the breeding season (Green et al. 2008).

White-tailed Deer Monitoring and Management

In 2008, the Service contracted with the USDA, Animal and Plant Health Inspection Service, and Wildlife Services to assist in studying the impacts of the deer population on plant communities within the refuge. Based on their analysis, they reported that the white-tailed deer population at John Heinz NWR was believed to surpass the carrying capacity of available habitat, causing severe ecological damage that negatively affected all other native species of plants and animals (D'Angelo 2012). See previous discussion under "Mammals" in Section 3.11 Refuge Biological Resources.

3.14 Refuge Visitor Services Program

The Refuge Improvement Act highlights six priority public uses that each refuge should evaluate for compatibility with its wildlife-first mandate. These six public uses include wildlife observation, interpretation, photography, environmental education, hunting, and fishing. John Heinz NWR currently provides opportunities for the public to participate in five of the six priority uses.

Environmental education, interpretation, wildlife observation, photography, and fishing are all provided via access throughout the refuge's extensive trail system. Kiosks and signs provide interpretive materials for trail users. The visitor center is an impressive facility, free to the public, Americans with Disabilities Act-compliant, and accessible by public and private transportation. The facility is visited by many schools and conservation organizations for classroom use and meeting space. The building is also an important example of sustainable design and environmentally friendly construction.

With over 10 miles of trails, the refuge provides many areas for visitors to explore (map 3.3). Most refuge visitors are families, wildlife observers, and neighborhood residents interested in viewing nature and wildlife. Well over 90 percent of the estimated 135,000 visitors take part in some sort of wildlife-dependent recreation activity, be it wildlife observation, photography, or fishing (table 3.8). Many visitors post images of refuge wildlife on the internet via photo-sharing sites. Fishing within Darby Creek draws regular visitation from surrounding communities throughout the summer months. While fishing is supported on the refuge, following State advisories, we encourage participants to practice catch and release due to the presence of contaminants within Darby Creek.

Table 3.8. Number of Refuge Participants by Activity (2009)*

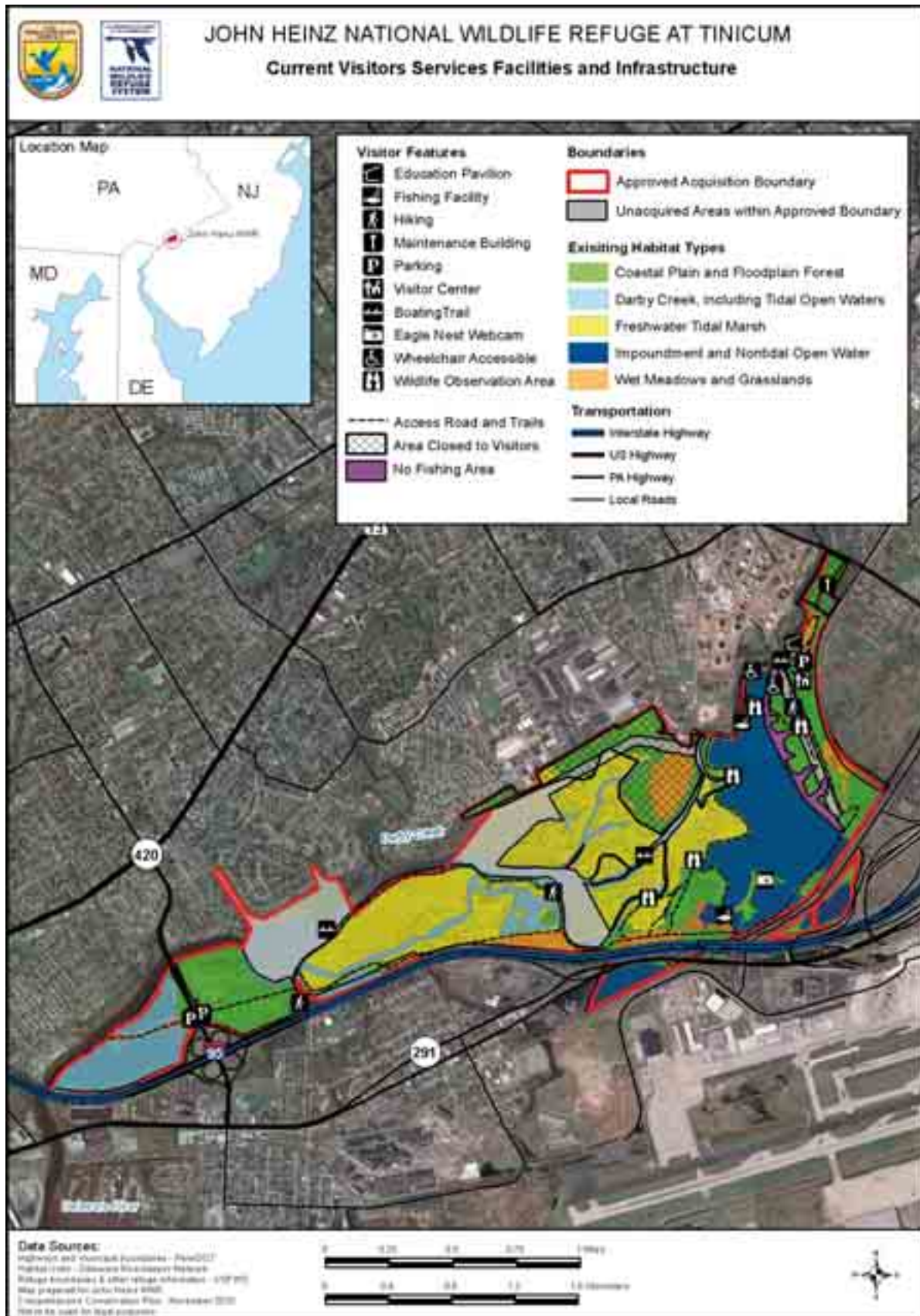
Activity	Number of Refuge Visitors
Wildlife Observation	133,000
Nature Photography	6,000
Freshwater Recreational Fishing	4,950
Environmental Education Programs Onsite	8,400
Environmental Education Programs Offsite	1,200
Interpretative Programs Onsite	13,300
Interpretative Programs Offsite	4,800

*Numbers outlined here are not additive. Refuge visitors may have participated in more than one activity during a visit. Numbers provided here are representative of the primary activity of a particular visit.

Annual refuge visitation is estimated through multipliers of the number of visitors by activity, from visitor contacts at refuge headquarters, road-traffic counts, program attendance, and observations by our refuge staff and volunteers. According to numbers reported by refuge staff, approximately 133,000 visits were made to the refuge in 2009. Out of this total, over 13,300 people visited the visitor center that same year. A summary of participants in refuge programs is provided below:

Being located in a large urban center allows the refuge to host a variety of visitors including school groups, homeschoolers, youth groups, family groups, anglers, birders, paddlers, bicyclists, refuge neighbors, surrounding community

Map 3.3. Current Visitor Service Facilities at John Heinz NWR



members, tourists (primary local, but regional, national and international visitor numbers are growing), as well as businesses.

The main goals of the visitor services program are to work with partners to promote the benefits of wildlife and habitat conservation and management; to foster an awareness and appreciation for the refuge and its role along the Atlantic flyway and within the Refuge System; and to provide quality wildlife dependent recreational experiences to visitors. Through these goals, refuge staff seek to develop a sense of environmental stewardship and conservation ethics in visitors.

The visitor services staff, and refuge staff overall, are passionate about and dedicated to, natural resources and their roles at the refuge; the entire staff is involved in the visitor services program. Since the refuge has been established, in part, to offer environmental education and wildlife-dependent recreation, refuge staff is not only in the business of habitat restoration and conservation, but also in “customer service” on behalf of the Service itself. For many residents of Philadelphia, the staff of John Heinz NWR may be their one and only interaction with the Service. Refuge staff is very active in outreach and partnership development. The refuge staff is dedicated to reaching out to new audiences, while maintaining the value of the refuge to its core audience.

Because environmental education is one of the establishing purposes of the refuge, much of the visitor services program focuses on environmental education programs. Currently, about 9,400 students a year participate in environmental education opportunities led by their teachers or by refuge staff and volunteers. Of that, 8,200 participate in onsite programs while another 1,200 participate in offsite programs. Education activities currently offered by refuge staff focus primarily on assisting teachers in developing environmental lesson plans for both onsite and offsite learning, sponsoring various onsite environmental workshops, and conducting onsite field trips for school groups.

Staff offer teacher trainings in delivering some of the widely-used conservation education programs such as Project WET, WILD, and Learning Tree workshops. About 200 teachers a year participate in these programs. Typical audiences for existing education activities consist of School District of Philadelphia elementary classes, summer camps, and some interest from local college programs for architecture, wildlife, and environmental studies. The refuge receives a number of education visits through field trips. These are generally guided by the teacher and/or chaperones that accompany the group. See appendix H (USGS Phase 1 Environmental Education Needs Assessment) for additional information on the refuge’s current environmental education program.

The refuge recently completed an environmental education needs assessment as part of the CCP process to identify opportunities for future refuge educational programming and reduce potential for overlap with similar programs across the refuge. This effort is being conducted in two phases: Phase 1 Summary of Current Environmental Education Program is included as appendix H. Phase 2 has recently been completed. Recommendations from Phase 2 will be incorporated into future visitor services planning.

The refuge is not open to hunting because of potential conflicts with local refuge regulations and safety and staffing availability concerns. PGC regulations only allow hunting within Philadelphia County through the use of archery or crossbows. While the refuge does not currently allow hunting, it does support hunting activities through sponsoring hunter education courses, managing the Pennsylvania Chapter of the Federal Junior Duck Stamp Program, and making informational materials available.

3.15 Archaeological and Historical Resources

The portion of the refuge within Tinicum Township now consists entirely of tidal marsh or artificial landforms, including the refuge dike system. Examination of historic maps as well as a sequence of aerial photographs beginning in the 1920s reveals that has been the situation for at least the last 150 years, probably far longer. However, two areas of terrace on the north side of Darby Creek in Folcroft and a considerably larger area within Eastwick appear to consist of natural upland having potential to contain intact pre-Contact Native American archaeological sites. Historic period archaeological sites could also exist in those three areas, though examination of historic maps and aerial photographs indicate that after the 17th century those areas were more likely used as pasture associated with farmsteads built closer to the historic road system.

Map evidence indicates that some refuge dikes follow the alignment of dikes constructed prior to the mid-19th century, some perhaps even originating in the 17th or 18th century. However, virtually all of the surviving dike system was modified in the mid-20th century by installation of water control structures, addition of interior dikes in some areas, and widening of most dikes to support a modern maintenance road system atop them. Erosion associated with relatively recent storm events has also obliterated considerable portions of the historic period system. Although the appearance of refuge dikes now differs substantially from that of the historic period, it seems probable that in at least some places the timber cribbing of early dikes may remain intact beneath wider modern cross-sections. Therefore, archaeological monitoring may be advisable if any future dike repairs will extend beneath the fabric of 20th century modifications.

Chapter 4

LaVonda Walton/USFWS



Judges review entries at the 2011 Federal Junior Duck Stamp Contest held at the refuge.

Management Direction and Implementation

- 4.1 Introduction
- 4.2 General Refuge Management
- 4.3 Conducting Additional NEPA Analysis
- 4.4 Refuge Goals, Objectives, and Strategies

4.1 Introduction

This chapter begins with a description of the process we used to formulate the management direction and implementation for John Heinz NWR. Next, we present the management direction and implementation for the refuge and identify decisions that we are not making at this time but will require additional NEPA analysis before a final decision can be made. We conclude with the goals, objectives, and strategies for managing each refuge.

The management direction and implementation we describe in this chapter includes a set of refuge goals, objectives to achieve those goals, and a series of strategies to implement them. The array of management actions described here are those that, in our professional judgement, will best achieve the refuge's purposes, vision, and goals, and best respond to public issues.

Refuge goals developed are intentionally broad, descriptive statements of the desired future condition of refuge resources. Goals articulate the principal elements of the refuge purposes and our vision statement, and provide a foundation for developing specific management objectives and strategies.

Objectives are essentially incremental steps toward achieving a goal; they further define management targets in measurable terms. Typically, they provide the basis for determining strategies that are more detailed, monitoring refuge accomplishments, and evaluating our successes. "Writing Refuge Management Goals and Objectives: A Handbook" (USFWS 2004a) recommends writing "SMART" objectives that possess 5 characteristics: (1) specific, (2) measurable, (3) achievable, (4) results-oriented, and (5) time-fixed. A rationale accompanies each objective to explain its context and importance. The objectives outlined in this chapter will guide the future development of refuge step-down plans, which we describe later in this chapter.

Strategies are the specific or combined actions, tools, or techniques we may use to achieve the objectives. The list of strategies in each objective represents the potential suite of actions we may implement. We will evaluate most of them further as to how, when, and where we should implement them when we write our refuge step-down plans. We will measure our successes by how well our strategies achieve our objectives and goals.

We believe the management goals, objectives, and strategies described below provide the best combination of actions to meet the Refuge System mission and policies; meet the refuge purposes, vision, goals; and respond to public issues. It emphasizes the management of specific refuge habitats to support focal species whose habitat needs benefit other species of conservation concern in the Delaware Estuary and southeastern Pennsylvania. In particular, we emphasize habitat restoration for globally rare plant communities and habitat types and related priority species of conservation concern. Under this plan, we will expand our freshwater tidal marsh restoration efforts, implement additional forest habitat restoration and management efforts, and increase the efficiency and effectiveness of our grassland management.

In addition, this plan will enhance our present visitor services programs in a manner that addresses the legislatively determined purposes of John Heinz NWR as well as national and regional Service policies and mandates. We will also expand administrative facilities to accommodate additional staff needed to implement these additional activities and to collocate refuge law enforcement with the other programs in an effort to improve cross-program coordination.

4.2 General Refuge Management

There are some actions we will take in managing John Heinz NWR over the next 15 years that are required by law or policy, or represent actions that have undergone previous NEPA analysis, public review, agency review, and approval. Others may be administrative actions that do not necessarily require public review, but we want to highlight them in this public document. They may also be actions we believe are critical to achieving the refuge's purpose, vision, and goals.

All of the following actions, which we discuss in more detail below, are current practices or policies that will continue:

- Using an adaptive management approach, where appropriate.
- Continuing land protection by purchasing fee title and conservation easements from willing sellers, and accepting donations, within the current, approved acquisition boundary.
- Controlling invasive species.
- Monitoring and abatement of diseases affecting wildlife and forest health.
- Controlling pest plants and animals.
- Facilitating or conducting biological research and investigations.
- Completing existing onsite projects managed by outside programs, such as restoring 55 acres of freshwater tidal marsh and site remediation of Folcroft Landfill.
- Developing a comprehensive GIS database for the refuge and the surrounding landscape to better inform and facilitate on-the-ground management.
- Completing findings of appropriate use and compatibility determinations.
- Providing refuge staffing and administration.

4.2.1 Adaptive Management

We will employ an adaptive management approach for improving resource management by learning from management outcomes. To provide guidance on policy and procedures for implementing adaptive management in departmental agencies, an intradepartmental working group developed a technical guidebook to assist managers and practitioners (Williams et al. 2009). It defines adaptive management, the conditions under which we should consider using it, the process for implementing it in a structured framework, and evaluating its effectiveness (Williams et al. 2009). In the guidebook adaptive management is defined as, “a decision process that promotes flexible decisionmaking that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood.”

At the refuge level, monitoring key resources and management actions and outcomes will be important to implementing an adaptive management process. Our freshwater tidal marsh restoration and management, invasive species, and impoundment management activities are examples of refuge programs or activities where an adaptive management approach may be implemented. The refuge manager will be responsible for changing management actions and strategies if they do not produce the desired conditions. Significant changes from what we present in this CCP may warrant additional NEPA analysis and public comment. Minor changes will not, but we will document them in our project evaluation or annual reports. Implementing an adaptive management approach supports all six goals of the refuge.

4.2.2 Protecting Land

The Service is authorized to protect 1,200 acres within its existing, approved refuge boundary. Currently, the Service has acquired 993 acres in fee title. We will continue to work with willing sellers and in partnership with other agencies and organizations to protect the remaining 207 acres within the refuge's authorized acquisition boundary.

It is impossible to predict the size, type, and location of future acquisitions that may come under our management within the next 15 years. Although the refuge seeks to acquire suitable and available habitat within its approved refuge boundary, concerted efforts to purchase those lands is not a primary focus of refuge management since the refuge already owns the majority of lands within its approved boundary. Instead, we will focus on creating partnerships with adjacent and nearby land owners in support of broader conservation issues that affect the refuge (e.g., habitat fragmentation).

The permanent protection of land is the keystone of wildlife and habitat conservation. Land protected by the Refuge System will be available forever to support fish, wildlife, and plants. We can restore, enhance, or maintain the land we own interest in to provide optimal conditions for Federal trust resources, such as threatened or endangered species and those species whose populations are in decline.

4.2.3 Managing Invasive and Pest Species

Invasive Species

The establishment and spread of invasive species, particularly invasive plants, is a significant problem that reaches across all habitat types. For the purposes of this discussion, we use the definition of invasive species contained in the Service Manual (620 FW 1.4E): "Invasive species are alien species whose introduction does or is likely to cause economic or environmental harm, or harm to human health. Alien species, or non-indigenous species, are species that are not native to a particular ecosystem. We are prohibited by Executive Order, law, and policy from authorizing, funding, or carrying out actions that are likely to cause or promote the introduction or spread of invasive species in the United States or elsewhere."

The unchecked spread of invasive plants threatens the biological diversity, integrity and environmental health of all refuge habitats. In many cases, they have a competitive advantage over native plants and form dominant cover types, reducing the availability of native plants as food and cover for wildlife. Over the past several decades, government agencies, conservation organizations, and the public have become more acutely aware of the negative effects of invasive species. Many plans, strategies, and initiatives target the more effective management of invasive species (e.g., USFWS 2004b, National Wildlife Refuge Association 2002). The Refuge System biological discussion database and relevant workshops continually provide new information and updates on recent advances in control techniques. Sources of funding are also available, both in the Service budget and through competitive grants, to conduct inventory and control programs.

Sixteen known invasive plant species targeted for invasive species management on the refuge are outlined in Section 3.12 Refuge Biological Resources of Chapter 3 "Existing Environment." Refuge staff currently focuses control on the following invasive plants, listed in alphabetical order by common name: bush honeysuckle, Canada thistle, phragmites, garlic mustard, Japanese hops, Japanese honeysuckle, Japanese knotweed, Japanese stiltgrass, mile-a-minute weed, multiflora rose, Norway maple, Oriental bittersweet, porcelainberry, purple loosestrife, and tree-of-heaven. Other invasive species have been identified, but have not been a focus of existing control efforts due to a combination of limited resources and the species' limited likelihood of additional expansion on the

refuge. Those species include European privet, princess tree, buckthorn, and reed canary grass. We also monitor refuge and adjacent lands and waters for the presence of invasive animal species, such as mute swans, feral cats, carp, red-eared slider, rusty crayfish, Asian stinkbugs, and snakehead, and are prepared to respond quickly to control them if discovered.

Of particular note, the emerald ash borer is an invasive insect that has spread throughout portions of the northcentral and eastern U.S., including Pennsylvania. Emerald ash borer was first identified in western Pennsylvania in 2007. A separate population was identified in central Maryland in 2003. Emerald ash borer larvae feed on the tissues under the bark of ash trees, causing the death of branches and entire trees (PADCNr 2010c). Since many of the floodplain forest communities of the refuge contain green ash as a dominant species, the location and expansion of emerald ash borer populations is another special concern.

Guidance on managing invasive species on refuges appears in the Service Manual (620 FW 1.7G). The following actions define our general strategies on the refuge:

- (1) Manage invasive species to improve or stabilize biotic communities to minimize unacceptable change to ecosystem structure and function and to prevent new and expanded infestations of invasive species.
- (2) Conduct refuge habitat management to prevent, control, or eradicate invasive species using techniques described through an integrated pest management plan, or other similar management plan, the plans comprehensively evaluate all potential integrated management options, including defining threshold/risk levels that will initiate the implementation of proposed management actions.
- (3) Evaluate native habitat management activities with respect to their potential to accidentally introduce or increase the spread of invasive species and modify our habitat management operations to prevent increasing invasive species populations.
- (4) Refuge integrated pest management planning addresses the abilities and limitations of potential techniques including chemical, biological, mechanical, and cultural techniques. See additional discussion on integrated pest management (section 3.3.3 below).
- (5) Manage invasive species on refuges under the guidance of the National Strategy for Invasive Species Management (USFWS 2004) and within the context of applicable policy.

The following actions define our specific strategies for the refuge:

- (1) Continue the treatment of the most problematic species ranked in management priority based on (a) the extent to which the species is established on the refuge, (b) the potential ecological impact of the species on refuge plant communities, and (c) the degree of management difficulty involved in controlling the species.
- (2) Maintain early detection and rapid-response readiness regarding new invasions.
- (3) Maintain accessibility to affected areas for control and monitoring.
- (4) Continue to promote research into the biological control alternatives.

- (5) Continue and increase efforts to involve the community in promoting awareness of invasive species issues, and seek assistance for control programs on and off the refuge.

Pest Species

At times, native plants and animals interfere with management objectives when they become overabundant. The Refuge Manual (7 RM 14.4A) defines a pest as, “Any terrestrial or aquatic plant or animal which interferes, or threatens to interfere, at an unacceptable level, with the attainment of refuge objectives or which poses a threat to human health.” That definition could include the invasive species defined above, but in this section, we describe some situations involving native species and under what conditions we will initiate control.

We use the following general strategies in pest management:

- (1) Determine the need for site-specific control based on the potential to affect our management objectives for a given area. We will employ an adaptive management strategy and we expect lethal control or removal of individual animals to be the exception rather than the rule. To establish general thresholds for lethal control is difficult. So we will determine our solution on a case-by-case basis. For example, in some years, spatterdock (also known as yellow pond lily) has expanded within the 145-acre impoundment to create a single-species population that vegetates managed mudflat habitat and outcompetes other native vegetation targeted for migratory bird management such as native, annual vegetation such as smartweeds, sedges, and rushes. As a result, we annually monitor establishment and expansion of spatterdock populations within the impoundment and adjust water level management to limit spatterdock expansion or selectively apply herbicides to favor establishment of desired annual native vegetation.
- (2) Employ integrated pest management techniques, when a species is having a significant impact on an area resulting in major habitat replacement and loss of valuable canopy trees (such as oaks) or desired native vegetation (such as sedges, rushes, and smartweeds).
- (3) Monitor results to ensure that pests do not exceed acceptable levels.

Integrated Pest Management

In accordance with 517 DM 1 and 7 RM 14, an integrated pest management approach will continue to be used, where practicable, to eradicate, control, or contain pest and invasive species (herein collectively referred to as pests) on the refuge. Integrated pest management involves using methods based upon effectiveness, cost, and minimal ecological disruption, which considers minimum potential effects to non-target organisms and the refuge environment. Pesticides may be used where physical, cultural, and biological methods or combinations thereof, are impractical or incapable of providing adequate control, eradication, or containment. Furthermore, pesticides will be used primarily to supplement, rather than as a substitute for, practical and effective control measures of other types. If a pesticide is used on the refuge, the most specific (selective) chemical available for the target species will be used unless considerations of persistence or other environmental or biotic hazards will preclude it. In accordance with 517 DM 1, pesticide usage will be further restricted because only pesticides registered with the USEPA in full compliance with the Federal Insecticide, Fungicide, and Rodenticide Act and as provided in regulations, orders, or permits issued by the USEPA may be applied on lands and waters under refuge jurisdiction.

Environmental harm by pest species is defined as a biologically substantial decrease in environmental quality as indicated by one or more of a variety of potential factors including declines of native species' populations or communities, degraded habitat quality or long-term habitat loss, or altered ecological processes. We define environmental harm as resulting in direct effects of pests on native species including preying and feeding on them; causing or spreading diseases; preventing other native species from reproducing or killing their young; out-competing other native species for food, nutrients, light, nest sites or other vital resources; or hybridizing with them so frequently that within a few generations, few if any truly native individuals remain. In contrast, environmental harm can be the result of an indirect effect of pest species. For example, decreased waterfowl use may result from invasive plant infestations reducing the availability or abundance of native wetland plants that provide forage during the winter.

We will refine our control program to address the most critical problems first. We may adjust our priorities to reflect regional Service priorities, the availability of new information, or a new priority resource.

4.2.4 Monitoring and Abating Wildlife and Plant Diseases

The Service has not yet published its manual chapter on Disease Prevention and Control. In the meantime, we derive guidance on this topic from the Refuge Manual and specific directives from the Director of the Fish and Wildlife Service or the Secretary of the Interior. The Refuge Manual (7 RM 17.3) lists three objectives for the prevention and control of disease:

- (1) Manage wildlife populations and habitats to minimize the likelihood of the contraction and contagion of disease.
- (2) Provide for the early detection and identification of disease mortality when it occurs.
- (3) Minimize the losses of wildlife from outbreaks of disease.

The Service published those objectives in 1982. Since then, in addition to diseases that cause serious mortality among wildlife, diseases transmitted through wildlife to humans have received more attention. One example is Lyme disease. In 2002, the Service published a Service Manual chapter (242 FW 5) on Lyme disease prevention to inform employees, volunteers, and national service workers about this disease, its prevention, and treatment. In addition to Lyme disease, several other wildlife and plant diseases are particularly concerning at John Heinz NWR, including avian influenza and avian botulism, Chronic Wasting Disease (CWD), Epizootic Hemorrhagic Disease (EHD), and oak diseases.

These are the general strategies for preventing or controlling disease:

- (1) Continue to conduct disease surveillance in conjunction with other fieldwork.
- (2) Cooperate with State agencies, particularly the PGC, PFBC, and Pennsylvania Natural Heritage Program, in conducting surveillance, providing access for sampling, and following protocols in the event of an outbreak.
- (3) Monitor forests and other habitats for indicators of the increased occurrence of pests or disease. For example, note changes in flowering or fruiting phenology, physical damage, decay, weakening, sudden death (particularly of canopy and source trees of major host species), and changes in wildlife use of habitats, such as the absence of breeding birds that used to appear regularly.

- (4) Follow the protocols in national, State, and refuge disease prevention and control plans.

Avian Influenza and Avian Botulism

Avian influenza is a serious wildlife disease that has received considerable attention worldwide. Of particular concern is the highly pathogenic Eurasian form (H5N1). In 2006, all refuges were instructed to prepare an Avian Influenza Surveillance and Contingency Plan. The John Heinz NWR Avian Influenza Surveillance and Disease Contingency Plan was approved in April 2007 and discusses methods for dealing with this disease (USFWS 2007a).

Avian botulism is caused when birds ingest a toxin produced by the bacteria, *Clostridium botulinum*. This bacteria is common in soils, but does not produce the toxin unless warm temperatures combine with a protein source and anaerobic (no oxygen) conditions (USGS 2011). Occasionally, large numbers of fish can die off during drawdowns of the impoundment. This can result in conditions conducive to production of the avian botulism toxin. Refuge staff monitor the impoundment during drawdowns to determine whether or not conditions for avian botulism are present. If these conditions are present, refuge staff may need to open the water control structure in periods of drought to allow additional water into the impoundment to prevent an outbreak of this disease in the refuge's waterfowl and waterbirds.

Chronic Wasting Disease

CWD is a fatal disease that attacks the brain and spinal cord of deer and elk. While the exact cause is unknown, it is believed to be caused by a prion, an altered protein that causes other normal proteins to change and cause sponge-like holes in the brain. CWD was first identified in the 1960s in a Colorado research facility. Since that time, it has been found in numerous states including the nearby States of New York and West Virginia. CWD has not been found in white-tailed deer in Pennsylvania. Prion diseases like CWD do not move easily between species. There is no scientific evidence that CWD has been transmitted to animals other than deer, elk, and moose. The Chronic Wasting Disease Surveillance and Contingency Plan for John Heinz NWR was approved in October 2007 (USFWS 2007b) and discusses early detection and response to any potential CWD occurrence at the refuge.

Epizootic Hemorrhagic Disease

EHD is a virus and the most common infectious disease of white-tailed deer in the eastern U.S. It is not transferable to humans and only rarely does it cause illness in other animals. EHD is spread from animal to animal by biting midges that live in or near water and wet, muddy areas. These midges transmit the virus as they feed. Outbreaks among white-tailed deer have occurred in Pennsylvania in 1996 (unconfirmed), 2002, and in 2007. Due to the midge being the main mode of transmission, control is very difficult and typically ineffective. More frequent exposure to the virus allows deer to develop immunity, allowing it to recover. EHD outbreaks in southern states, which occur more frequently than in more northern states, typically have lower mortality rates than what is seen when the disease comes to Pennsylvania (PGC 2011). However, the New Jersey Department of Environmental Protection Division of Fish and Wildlife's Office of Fish and Wildlife Health and Forensics, reported a documented outbreak of Type 2 EHD in Salem County (approximately 20 miles from the refuge) in the fall of 2010. This outbreak of Type 2 EHD in New Jersey raises concern that this strain may persist and reoccur annually as it does in the southern U.S. (NJDEP 2010).

Oak Diseases

Diseases can affect forest health as well. Diseases that affect oaks are a special concern because of the importance of the coastal plain forest community which is dominated in part by pin oaks. More than 80 documented insects and diseases affect oak trees in the U.S. Their impacts range from minor defoliation to rapid mortality. In some years, pests cause the loss of a major portion of the acorn crop, impeding oak regeneration. A few pests have altered or may alter eastern U.S. oak forests on a broad scale. For example, humans' inadvertently transporting masses of eggs have aided the spread of the gypsy moth, an introduced defoliator, in the last few decades.

4.2.5 Biological and Ecological Research and Investigations

The Refuge Manual and the Service Manual both contain guidance on conducting and facilitating biological and ecological research and investigations on refuges. In 1982, the Service published three objectives in the Refuge Manual for supporting research on units of the Refuge System (4 RM 6.2):

- (1) Promote new information and improve the basis for, and quality of, refuge and other Service management decisions.
- (2) Expand the body of scientific knowledge about fish and wildlife, their habitats, the use of these resources, appropriate resource management, and the environment in general.
- (3) Provide the opportunity for students and others to learn the principles of field research.

In 2006, the Service Manual provided supplemental guidance on the appropriateness of research on refuges: "We actively encourage cooperative natural and cultural research activities that address our management needs. We also encourage research related to the management of priority general public uses. Such research activities are generally appropriate. However, we must review all research activities to decide if they are appropriate or not as defined in section 1.11. Research that directly benefits refuge management has priority over other research" (603 FW 1.10D (4)).

All research conducted on the refuge must be consistent with an approved finding of appropriateness and compatibility determination for research. If a research project does not fall within the scope of a current finding of appropriateness and compatibility determination, we will need to complete a project-specific finding of appropriateness and compatibility determination before issuing a special use permit. Research projects may also contribute to a specific need identified by the refuge or the Service. As we note in chapter 3, we have allowed many research projects that meet these criteria. A special use permit will be issued for all research projects we allow. In addition, we will employ the following general strategies:

- (1) Seek qualified researchers and funding to help answer refuge-specific management questions.
- (2) Participate in appropriate multi-refuge studies conducted in partnership with the USGS, USDA, State agencies, and others.
- (3) Facilitate appropriate and compatible research by providing compatible access and utilization of the refuge as a location for ongoing research.

4.2.6 Completing Existing Projects Outside the Scope of the CCP Process

Several projects in progress on the refuge are being managed by programs outside of the refuge either due to funding sources or jurisdiction. Although these projects are occurring on the refuge, NEPA compliance for these projects is

being addressed outside this CCP because they are being planned and analyzed by other Service programs or other Federal agencies.

The Service's Chesapeake Bay Ecological Services office in Annapolis, Maryland, is spearheading efforts to restore 55 acres of freshwater tidal marsh that is currently a phragmites-dominated wetland. Funding for this project's design and construction has been secured and is provided through the Natural Resource Damage Assessment settlement on behalf of the 2006 Athos oil spill on the nearby Delaware River. Currently, the Chesapeake Bay Ecological Services office is planning the project and will comply with NEPA as needed. This project will be the largest freshwater tidal marsh restoration project on the refuge once completed.

Remediation of the Folcroft Landfill is another large-scale effort that will likely continue for years before completion. The USEPA is leading the multi-agency effort to complete the characterization and remediation of the Folcroft Landfill. At the time of this writing, the USEPA finalized a legal agreement with a group of potentially responsible parties requiring them to perform the Remedial Investigation and Feasibility Study. The Service owns the Folcroft Landfill as part of the refuge. Field investigations on the site started at the end of November 2006 and continued until summer of 2007. During this time, groundwater wells were installed and sampled and soil samples were collected. This environmental data will be included in the Remedial Investigation and Feasibility Study for the Folcroft Landfill which is currently underway. The Remedial Investigation for the Folcroft Landfill was recently submitted to the USEPA and is currently being reviewed. Once remediation is complete, the Service will manage these lands according to an approved plan. At that time, we will determine which public uses will be allowed.

4.2.7 Protecting Cultural Resources

As a Federal land management agency, we are responsible for locating and protecting all historic resources, specifically archaeological sites and historic structures eligible for listing or listed on the National Register of Historic Places. That applies not only to refuge land, but also to land affected by refuge activities, and includes any museum properties. We are not aware of any documented archaeological resources on the refuge at this time.

Modifications to refuge structures dating over 50 years in age, construction of new refuge facilities, and habitat modifications requiring earthmoving are all subject to review under Sec. 106 of the National Historic Preservation Act. That review process requires consultation with the Pennsylvania Historical and Museum Commission and federally recognized Tribes, as well as any other interested parties that may be identified during the process. The potential for intact pre-contact or historic period resources that could be affected by a refuge undertaking varies according to the characteristics of natural landforms, extent of modern disturbance, and nature of the undertaking itself.

Under this plan, we will evaluate the potential for our management activities to impact archaeological and historical resources as required, and will consult with the Service's regional archaeologists, Pennsylvania Historical and Museum Commission, and appropriate federally recognized Tribes to ensure compliance with Section 106 of the National Historic Preservation Act and any other applicable laws and regulations. That compliance may require any or all of the following: a State Historic Preservation Records survey, literature survey, or field survey.

4.2.8 Wildlife-dependent Recreational Program

The Refuge Improvement Act designated six priority public uses on National Wildlife Refuges: hunting, fishing, wildlife observation, photography, environmental education, and interpretation. We will continue to use the criteria

specified in Service policy (605 FW 1) for a quality wildlife-dependent recreation program in developing refuge programs (also see chapter 1, section 1.3).

While no formal survey has been conducted, observations by refuge staff indicate that most visitors to the refuge engage in some form of wildlife-dependent recreation. Wildlife observation and onsite environmental interpretation are the two most common activities (see chapter 3, section 3.14). The refuge offers opportunities for five of the six designated priority uses. The refuge does not allow hunting because of public safety concerns and compliance with local regulations. Despite the exclusion of hunting from the refuge, we still support hunting as an activity through sponsoring related activities such as hunter-education and archery programs.

In recent years, the Service has recognized the importance of connecting children with nature. Scholars and health care professionals are suggesting a link between a loss of connection with the natural world and many physical and mental problems in our nation's youth (Louv 2005). We will continue to promote the concept of connecting children with nature in all of our compatible recreational programming. Our partners, Friends of the Heinz Refuge, and other volunteers will continue to help us expand these priority public use programs.

4.2.9 Appropriateness and Compatibility Determinations

Chapter 1 describes the requirements for determinations of appropriateness and compatibility. Appendix B includes appropriateness and compatibility determinations consistent with implementing this CCP. All existing findings of appropriateness and compatibility determinations have been updated with this CCP. These activities were evaluated based on whether or not they contribute to meeting or facilitating refuge purposes, goals, and objectives. As noted above, hunting, fishing, wildlife observation and photography, and environmental education and interpretation, when compatible, are the priority wildlife-dependent uses of the Refuge System. According to Service Manual 605 FW 1, these uses will receive preferential consideration in refuge planning and management before the refuge manager analyzes other public uses for appropriateness and compatibility.

4.2.10 Activities Not Allowed

According to Service policy, (603 FW 1), if the refuge manager determines a use is not appropriate, it can be denied without determining its compatibility. As specified in the Refuge Administration Act, we cannot, "initiate or permit a new use of a refuge or expand, renew, or extend an existing use of a refuge" unless we have determined that the use is compatible. In addition, certain uses are generally or specifically prohibited on refuges by Service regulation (see 50 C.F.R. §27 for details). Therefore, the refuge is closed to public uses except those specified in this plan. Upon request, the refuge manager determines, in writing, appropriateness and, if applicable, compatibility for nonpriority public uses.

4.2.11 Activities Allowed

Some activities are already approved through an existing finding of appropriateness and compatibility determination. These include research, wildlife observation, photography, environmental education and interpretation, recreational fishing, and bicycling for the purposes of accessing wildlife-dependent recreation opportunities (limited to existing access roads). We are in the process of updating these compatibility determinations, which are included in appendix B for public review and comment. Appendix B details our proposals for all of those activities.

4.2.12 Refuge Staffing and Administration

Our proposals in this document do not constitute a commitment for staffing increases, or funding for operations, maintenance, or future land acquisition. Congress determines our annual budgets, which our Washington Headquarters and regional offices distribute to the field stations. Chapter 3 presents our levels

of staffing and operating and maintenance funds for the refuge over the last 5 years.

Permanent Staffing and Operational Budgets

Our objective is to sustain levels of annual funding and staffing that allow us to achieve refuge purposes, as interpreted by the goals, objectives, and strategies that we have established in this CCP. We achieved many of our most highly visible projects since refuge establishment through special project funds that typically have a one- to two-year duration. Although those funds are very important, their flexibility is limited, because we cannot use them for any other priority project that may arise. As previously mentioned, funding for land acquisition derives primarily from two sources: the Land and Water Conservation Fund and the Migratory Bird Conservation Fund. We generally direct the funds from those sources at specific acquisitions.

We will seek to fill any currently approved but vacant positions, which we believe are necessary to accomplish our highest priority projects. We also propose additional staff to support expanded biological and visitor services programs. We identify our recommended priority order for new staffing in the Refuge Operating Needs tables in appendix E. We also seek an increase in our maintenance staff, because they provide invaluable support to all program areas. Appendix D identifies current and proposed staffing levels.

Facilities Construction and Maintenance

Congress passed legislation establishing the refuge in 1972, but construction of the visitor center did not begin until 2000. Since its completion in 2001, no other major building construction has occurred on the refuge. The refuge did install a paved, 0.6-mile, handicapped-accessible trail loop near the visitor center and main parking lot in the summer of 2009. In 2011, the refuge completed installation of an outdoor pavilion. The outdoor pavilion was developed to better accommodate large school and community groups. While the visitor center provides large meeting space and smaller classroom facilities, the outdoor pavilion allows these groups to more effectively utilize their limited time on the trail and spend more time outside, experiencing the refuge.

We will continue to make incremental progress in upgrading appropriate facilities to current Americans with Disabilities Act standards. We will also continue to improve access and refuge visibility in the community for visitors. We have identified the need for additional directional signs both on and offsite. We will work with the Pennsylvania Department of Transportation (PENNDOT), SEPTA, and the city of Philadelphia to improve directional signs offsite.

Improved signage will help raise the visibility of the refuge and the Service in the region. As observed by refuge staff, and verified by numerous Web postings and blogs, the refuge remains unknown to many people living near the refuge. We must also take care to upgrade and maintain all facilities to Service standards to keep them safe, fully accessible, functional, and attractive.

Distributing Refuge Revenue Sharing Payments

As discussed in chapter 3, we pay local municipalities in Philadelphia and Delaware Counties annual refuge revenue sharing payments based on the number of acres in each municipality and the appraised value of refuge lands in their jurisdiction. We will continue these payments in accordance with the Revenue Sharing Act, commensurate with changes in the appraised market value of refuge lands, or new appropriation levels dictated by Congress.

Refuge Operating Hours

We will open the refuge for public use from official sunrise to sunset, 7 days a week. We close the refuge after dark to help ensure visitor safety and protect refuge resources. However, the refuge manager does have the authority to issue a special use permit to allow others access outside those periods. For example, we may permit access for research personnel or wildlife control specialists at different times, or organized groups to conduct nocturnal activities, such as wildlife observation, and educational and interpretive programs.

4.2.13 Conducting a Wilderness Review

The Refuge System planning policy requires that we conduct a wilderness review during the CCP process. The first step is to inventory all refuge lands and waters the Service owns in fee simple. Our inventory of this refuge determined that no areas meet the eligibility criteria for a wilderness study area as defined by the Wilderness Act. Therefore, we did not analyze further the refuge's suitability for wilderness designation. See appendix F for the results of the wilderness inventory. The refuge will undergo another wilderness review in 15 years as part of the next comprehensive conservation planning process.

4.2.14 Conducting a Wild and Scenic Rivers Review

Service planning policy also requires that we conduct a wild and scenic rivers review during the CCP process. We inventoried the segment of the Darby Creek that flows through the refuge, and determined that it does not meet the criteria for wild and scenic river eligibility (see appendix G). As such, we are not pursuing further study to determine suitability, nor recommending this segment of the river be designated as wild and scenic at this time. Should another State or Federal agency, or a non-governmental partner, initiate a study, we will participate in that effort.

4.2.15 Completing Refuge Step-down Plans

Service planning policy identifies 25 step-down plans that may be applicable on any given refuge. The existing step-down plans in place on the refuge are listed below.

- Annual habitat work plan (most recently completed 2010, updated annually).
- Wildlife disease surveillance and contingency plan (completed 2006).
- Fire management plan (most recently completed 2006, updated annually).
- Hurricane action plan (most recently completed 2010, updated annually).
- Environmental management plan (most recently completed 2003, updated annually).
- Safety plan (most recently completed 2010, updated annually).

We have identified the habitat management plan, annual habitat work plan, inventory and monitoring plan, integrated pest management plan, and the visitor services plan as high-priority step-down plans to update or complete. We describe them in more detail below. To keep them relevant, we will modify and update them as we obtain new information. The completion of these plans supports all refuge goals.

We will complete additional step-down plans as follows:

- Visitor services plan, drafted in 2012, finalized within 3 years of CCP approval (see discussion below).
- Habitat management plan will be finalized at the same time as the CCP (see discussion below).

- Annual habitat work plan, annually after CCP approval (see discussion below).
- Inventory and monitoring plan, annually after CCP approval (see discussion below).
- Integrated pest management plan, within 3 years of CCP approval (see discussion below).
- Law enforcement plan, drafted in 2012, within 1 year of CCP approval.
- Deer management plan, finalized in conjunction with the final CCP.
- Fishing management plan, within 3 years of CCP approval.

Visitor Services Plan

The visitor services plan for the refuge will be finalized with 3 years of CCP approval. Visitor services plans encompass all aspects of visitor services on the refuge and will include an environmental education plan and a facilities and sign plan including a section on environmental education. The visitor services plan will consider carrying capacity of the refuge to balance visitor use with wildlife habitat. It will identify, define, and prioritize audiences and identify themed messages and topics that will apply to all environmental education and interpretation programming. Given the importance of environmental education to the refuge, and the refuge's critical role in connecting young people with nature and representing the Refuge System and the Service in an urban environment, developing and implementing a visitor services plan is particularly important at John Heinz NWR. For this reason, John Heinz NWR staff will begin writing the refuge's visitor services plan as soon as possible.

Habitat Management Plan

An HMP for the refuge is the requisite first step toward achieving the objectives of goals 1 and 2. The HMP will incorporate the CCP's habitat objectives developed herein, and will identify "what, which, how, and when" actions and strategies will be implemented over the 15-year period to achieve those objectives. Specifically, the HMP will define management areas and treatment units, identify the type or method of treatment, establish the timing for management actions, and define how we will measure success over the next 15 years. In this CCP, the goals, objectives, and list of strategies in each objective identify how we intend to manage habitats on the refuge. We based both the CCP and HMP on current resource information, published research, and our own field experiences. We will update our methods, timing, and techniques as new, credible information becomes available. To facilitate our management, we will regularly maintain our GIS database, documenting any major changes in vegetation at least every 5 years.

Annual Habitat Work Plan and Inventory and Monitoring Plan

The annual habitat work plan and inventory and monitoring plan for the refuge are also priorities for completion upon CCP approval. Those plans also are vital for implementing habitat management actions and measuring our success in meeting the objectives. Each year, we will generate from the HMP and annual habitat work plan that will outline specific management activities for that year. The inventory and monitoring plan will outline the methodology to assess whether our original assumptions and proposed management actions support our habitat and species objectives. We will prioritize our inventory and monitoring needs in the inventory and monitoring plan. The results of inventories and monitoring will provide us with more information on the status of our natural resources and allow us to make more informed management decisions.

Integrated Pest Management Plan

The refuge's integrated pest management plan will be completed within 3 years of CCP approval. The integrated pest management plan supplements both the CCP and HMP with documentation on how to manage invasive or pest species. Along with a more detailed discussion of integrated pest management techniques, the integrated pest management plan describes the selective use of pesticides for pest management on the refuge, where necessary. Throughout the life of the CCP or HMP, most proposed pesticide uses on the refuge will be evaluated for potential effects to refuge biological resources and environmental quality. These potential effects will be documented in "Chemical Profiles" in the forthcoming integrated pest management document. Pesticide uses with appropriate and practical best management practices for habitat management as well as cropland and facilities maintenance will be approved for use on the refuge where there likely will be only minor, temporary, and localized effects to species and environmental quality based upon non-exceedance of threshold values in chemical profiles. However, pesticides may be used on a refuge where substantial effects to species and the environment are possible (exceed threshold values) in order to protect human health and safety (e.g., mosquito-borne disease). Pesticide use proposals are submitted annually for each herbicide to acquire approval prior to management applications.

4.3 Conducting Additional NEPA Analysis

For all major Federal actions, NEPA requires the site-specific analysis and disclosure of their impacts, either in an EA or in an Environmental Impact Statement. Most of the major actions in this CCP were fully analyzed in the draft CCP/EA and are described in enough detail to comply with NEPA, and will not require additional environmental analysis. Although this list is not all-inclusive, the following projects fall into that category:

- The HMP, including its specified restoration projects and habitat management programs.
- The white-tailed deer management plan.
- Constructing a boardwalk into Tinicum Marsh.
- Controlling invasive plants.
- Changing our priority public use programs, with the exception of new hunting and fishing proposals if applicable.

The current fire management plan has already completed the NEPA analysis process. Those environmental documents can be requested from refuge headquarters.

4.4 Refuge Goals, Objectives, and Strategies

4.4.1 Land Protection

We will continue to work with willing sellers and in partnership with other agencies and organizations to acquire the remaining 207 acres within the refuge's approved acquisition boundary.

4.4.2 Habitat Management

Habitat management will expand freshwater tidal marsh restoration within the refuge. Since protecting and preserving Tinicum Marsh is one of the refuge's establishing purposes, and it supports the greatest number and diversity of species of conservation concern, we will increase management resources for

controlling or eliminating invasive species, restoring freshwater tidal marsh, and monitoring and adapting to climate change.

Forest habitat restoration will also be expanded. This includes the restoration of a 15-acre forest stand currently dominated by a nonnative gray poplar to a mix of native coastal plain tree species. We will also initiate a deer management program. Controlling the size of the resident deer herd will improve natural regeneration of native species and enhance habitat for other wildlife such as birds, amphibians, reptiles, and small mammals.

Habitat management on the refuge will expand utilization of partnerships to enhance biological programs. In doing so, our staff can leverage the resources and expertise of our various partnerships to accomplish the goals and objectives we have set forth.

Habitat types predicted under this plan are displayed on map 4.1.

4.4.3 Inventory and Monitoring

We will continue existing monitoring and inventory efforts as long as they continue to provide useful information that will inform us about the effectiveness of habitat management, habitat adaptation to climate change, and we have the necessary resources to accomplish them. We will target any alterations or additions to these ongoing surveys toward helping us understand better the implications of our management actions and ways to improve our efficiency and effectiveness. We will also continue to seek ways to reduce our management costs for establishing and maintaining monitoring protocols.

We will expand our inventory and monitoring to inform our understanding of how sea level rise may impact our long-term habitat management. Long-term monitoring stations dedicated to measuring parameters related to marsh response to sea level rise will be monitored throughout the life of this CCP. We will also expand biological inventories and monitoring projects to improve our knowledge and understanding of species that utilize the refuge.

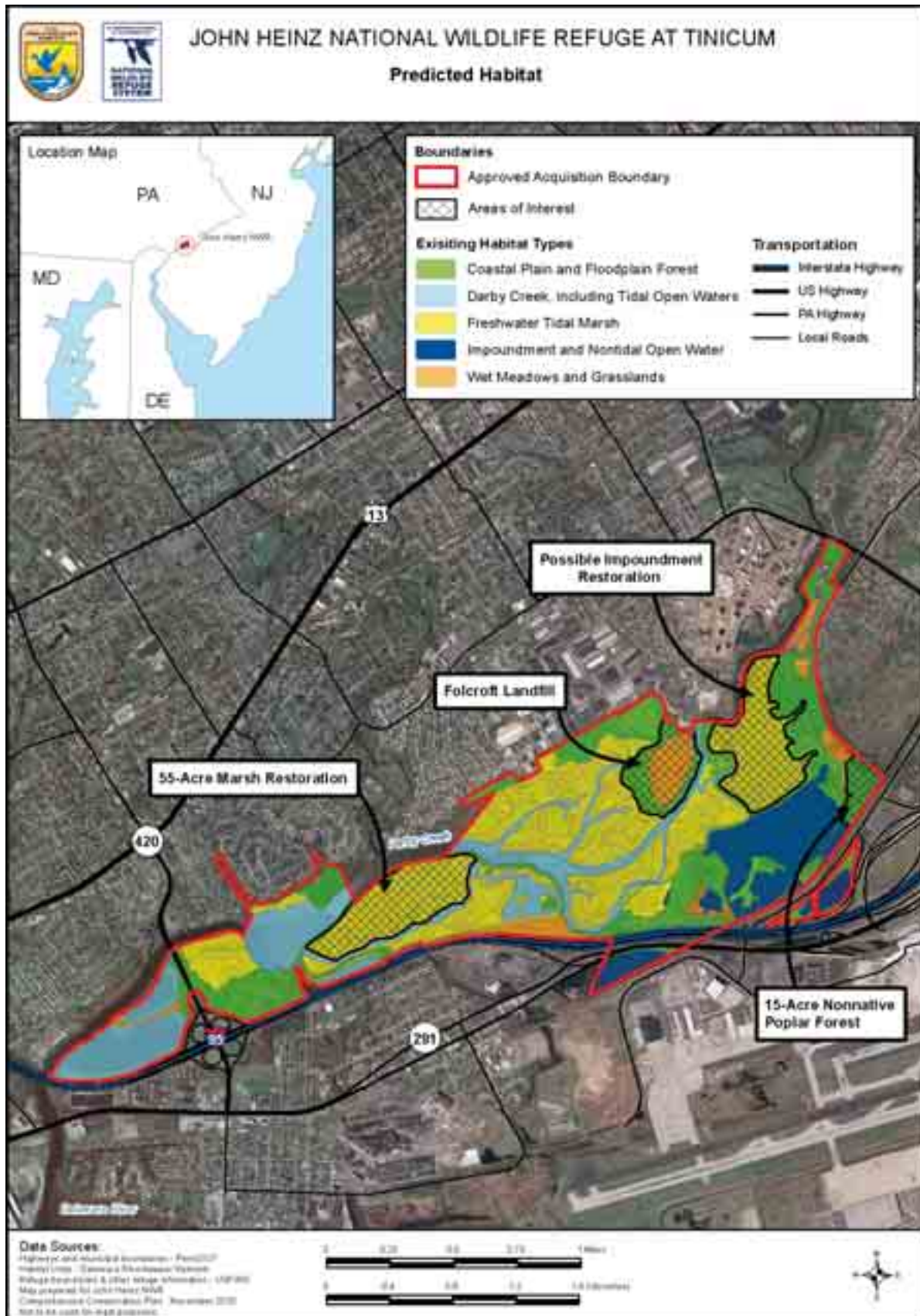
4.4.4 Visitor Services

We will expand existing opportunities for five of the six priority public uses, with an emphasis on expanding our environmental education program. Map 4.2 presents the current and proposed public use facilities under this plan. We will use the results of the Environmental Education Stakeholder Needs Assessment Phase II (Wells and White 2011) to help refuge staff develop a series of environmental education programs that are unique to the refuge.

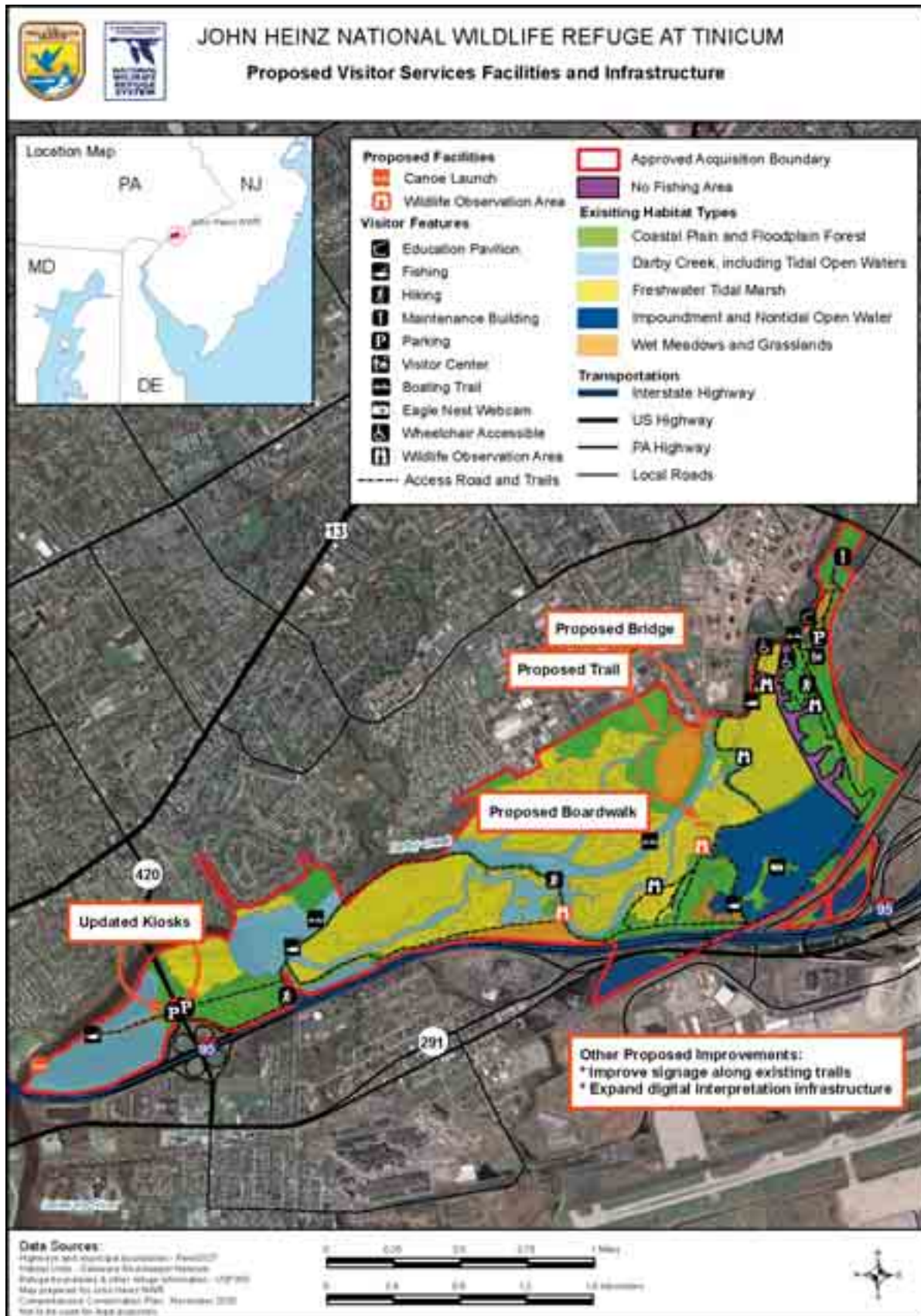
Environmental interpretation will also be updated and improved. Refuge interpretive infrastructure such as signs, kiosks, and displays will be improved and updated, and additional kiosks will be added. We will also provide more interpretive options readily accessible to urban youth and more technologically savvy visitors such as podcasts, virtual tours, and interactive programs available via the refuge Web site, cell phone, or podcast-based self-guided tour options. We will also provide more programs and materials in different languages and for visitors with disabilities.

Because of our efforts to expand programs and facilities under this plan, we expect total refuge visitation to increase. We estimate total refuge visitation to reach approximately 196,300 visits over the life of the plan. Most of this increase is expected in onsite environmental education, interpretation, and wildlife observation.

Map 4.1. Proposed Habitats Comprising John Heinz NWR



Map 4.2. Proposed Visitor Services Facilities at John Heinz NWR



In expanding opportunities for compatible wildlife-dependent recreation, we hope to contribute to communities and businesses around the refuge, both in terms of health and well-being, and economically. We will join other agencies and organizations to promote connecting children with nature. A growing body of research suggests that a lack of direct involvement with the outside world may be contributing to a variety of social issues affecting children today (Louv 2005). By offering places and programs where children and their parents can observe wildlife in natural settings, and participate in other wildlife-dependent recreation such as photography and fishing, we will contribute to the growing national initiative to reconnect children with nature.

4.4.5 Refuge Administration

Under this plan, we will expand refuge staff to support expanded habitat management efforts and increases in the visitor services program. We propose to add up to five positions: a regional visitor services coordinator (stationed at the refuge), a park ranger/volunteer coordinator, a biological technician, a maintenance worker, and an administrative assistant (see proposed staff chart in appendix D). We will base any increases in staffing on available sources of funding, and will make personnel decisions based on regional and refuge priorities.

We propose expanding administrative facilities to accommodate the additional staff and collocate refuge law enforcement with the other refuge programs (see appendix J for conceptual design plan). Under current management, maintenance and law enforcement are housed in a separate building located approximately one-quarter mile from the visitor center and refuge's administrative offices. Expanding existing offices to collocate all staff will allow the refuge to achieve the regional priority of housing all refuge programs under the same roof to improve cross-program coordination. All other facilities will be maintained and upgraded to meet safety and accessibility requirements over the 15-year life of the plan.

4.4.6 Goals, Objectives, and Strategies to Meet Refuge Goals

GOAL 1.

Protect, maintain, and restore where possible, the biological integrity, diversity, and environmental health of southeastern Pennsylvania Coastal Plain ecological communities that are unique to the refuge and sustain native plants and wildlife, including species of conservation concern.

Strategies that apply to all objectives under this goal include:

- Recruit, hire, and train interns, volunteers, and students to assist with aspects of biological management including invasive species control and biological monitoring.
- Support Friends of Heinz Refuge to assist with aspects of biological management such as invasive species control.
- Continue to develop memorandums of understanding or memorandums of agreement for in-holdings to allow for habitat management and law enforcement, where important for maintaining refuge resources and public safety.
- Work with PENNDOT and Philadelphia International Airport to evaluate the extent of effects on the refuge of traffic and airport noise on birds, amphibians, and other wildlife in order to determine if a sound barrier is needed and if so, the most effective size, type, and location of sound barriers around the refuge.

- Within 7 years of plan approval, coordinate with partnering agencies and non-governmental organizations to conduct plant and animal species inventories and monitoring to obtain updated information on refuge populations, their distribution, and indicators of habitat use.

Objective 1.1 Freshwater Tidal Marsh

Over the next 15 years, protect the existing 282 acres of freshwater tidal marsh within the refuge, improve 55 acres of this existing habitat, and acquire and restore up to 70 additional acres as opportunities arise. Restore up to 103 acres to freshwater tidal marsh throughout the refuge. Restored and improved marsh will be dominated by native marsh vegetation including, but not limited to, wild rice (*Zizia aquatica*), spatterdock (*Nuphar lutea*), pickerelweed (*Pontederia cordata*), and tick-seed sunflower (*Bidens* spp.). Restored marshes will reestablish greater than 80 percent coverage of native marsh plant species and tidal hydrology that inundates greater than 90 percent of the marsh plain surface with shallow water (less than 1-foot maximum depth) at mean high tide and results in the development of natural channels across the marsh plain surface.

Rationale

Approximately 5 percent of the original acreage of freshwater tidal marsh remains within the Delaware Estuary, amounting to 28,921 acres (11,709 hectares) based on the latest available 1980s data from the National Wetland Inventory. Nevertheless, the Delaware Estuary still supports more of this marsh type than any other estuary in the nation (Kreeger et al. 2010). The Pennsylvania Natural Heritage Program estimates that Philadelphia County at one time contained 6,400 to 12,800 acres (10 to 20 square miles) of freshwater tidal marsh (PNHP 2008). Historically, these wetlands provided an important breeding spot for many bird, mammal, fish, and insect species. It was also a critical stopover site for migratory waterfowl and shorebirds during their annual migrations. Today, John Heinz NWR protects the largest remnant of freshwater tidal marsh, roughly 285 acres (one-third square mile) that remains in this part of the State (PNHP 2008). Freshwater tidal marshes are some of the most biologically productive ecosystems in the world: containing high plant diversity and supporting more bird use than any other wetland type (Mitch and Gosselink 1993). Coastal marshes (including freshwater tidal marshes) are among the highest priority habitats within Bird Conservation Region 30 due to impacts from surrounding land use, rates of loss, or lack of information on present spatial distribution (USFWS 2008a).

Although this remnant area of freshwater tidal marsh has been severely degraded over the years, it still supports a variety of species unique to the surrounding landscape and region. Nine of the 22 priority species of conservation concern identified in the refuge's HMP are primarily associated with this habitat type. At least another 8 of these 22 species also use the marsh habitat. Vegetation structure, microhabitat conditions (elevations relative to mean high tide, presence of small channels across the marsh plain, occasional shrubs or small trees), and landscape context (surrounding land use, size, and contiguousness) are more critical habitat components for species of concern, rather than specific plant species. However, the presence of high marsh, that is, portions of marsh that are at the upper extent of the high tide fluctuation and subject to shorter durations of inundation tend to support a greater variety of plant species and suitable nesting sites for species such as American bittern, least bittern, king rail, and marsh rice rat.

Several State-listed endangered or threatened waterbird species use wetlands across the refuge including American bittern, great egret, king rail, and least bittern. These species primarily use a combination of the freshwater tidal marsh habitat and nearby open waters such as Darby Creek and the impoundment. The freshwater tidal marsh provides breeding habitat for all of these State-listed species, while the open waters provide foraging habitat.

Protecting and preserving Tinicum Marsh is one of the originally mandated purposes of John Heinz NWR. Given these factors, we consider restoration and conservation of freshwater tidal marsh to be the highest priority for habitat management. The Restoration Management Plan for Lower Darby Creek identifies areas of historic tidal marsh that have been severely altered along with the approximate date of impact (Salas et al. 2006). Some of these areas are suitable locations for restoration of tidal marsh habitat. Refuge staff has recently restored approximately 10 acres of tidal marsh that was previously dominated by phragmites. Under this plan, we will pursue additional restoration of freshwater tidal marsh with the understanding that (a) restoration of existing degraded systems to freshwater tidal marsh will provide greater conservation benefit for an unspecified duration, (b) to the extent possible, restoration efforts must incorporate some resiliency to accommodate potential effects of climate change (e.g., sea level rise), and (c) that, with sufficient monitoring and evaluation, we will be able to apply adaptive management to marsh areas in light of actual changes in sea level rise and salinity.

About 60 acres of the refuge's tidal marsh are currently dominated by nonnative phragmites. Many of these populations are smaller than 0.5 acres. Marsh vegetation and elevation surveys completed in 2005 documented the correlation between marsh plain elevations and species composition (Salas et al. 2006). Phragmites was found to generally inhabit the same zone as the highly diverse areas of high marsh which provide the most suitable nesting habitats for waterbirds (Weller 1961, Palmer 1962, Meanley 1969, Kushlan 1973, Harrison 1978, Aniskowicz 1981). As such, controlling and reducing the coverage of phragmites across the freshwater tidal marsh will provide improved breeding site opportunities.

Planned restoration for a 55-acre area dominated by phragmites will restore tidal hydrology across a marsh surface. The restoration is intended to not only restore a native freshwater tidal marsh plant community, but also expand available aquatic habitat. Strategy 3 of the National Fish Habitat Action Plan (NFHAP 2006) (Reconnecting fragmented river systems and spawning and nursery habitats) will be addressed in development of this project. Planned marsh design will incorporate surface channels similar to those present under reference conditions in other portions of the marsh.

Recent reports projecting the potential effects of climate change, have underscored the high importance of monitoring freshwater tidal and other coastal marshes for their long-term conservation (USFWS 2008, Kreeger et al. 2010). Due to the unique landscape context of John Heinz NWR being situated within the Philadelphia metropolitan area, at the base of a highly urbanized watershed and at the confluence of Darby Creek with the Delaware River, as well as being less than 1 mile upstream from the river's salt line, the refuge's freshwater tidal marsh is particularly vulnerable to changing sea levels. Alteration in the balance of marsh elevations, sediment accretion rates, sea levels, and salinity can have major impacts on the existing marsh area. SLAMM modeling completed for the wetlands within John Heinz NWR indicates that up to 92 percent of the refuge's tidal marsh may be converted to shallow open water habitat over the next 100 years, depending on the extent of sea level rise. Recent literature (Chen et al. 2006, Monaghan et al. 2006) indicates that the global rise in sea levels is progressing more rapidly than was previously assumed, perhaps due to the dynamic changes in ice flow omitted within the IPCC report's calculations (Clough et al. 2010). At this time, it is unclear to what extent sea level will rise and how it might affect the refuge (UCS 2008). Due to this uncertainty, the refuge needs to create a marsh monitoring program to document and evaluate local trends in sedimentation rates, vegetative cover and species composition, as well as changes in percent of marsh surface as open water at low tide. During

the summer of 2010, scientists from the Academy of Natural Sciences and the Partnership for the Delaware Estuary have initiated research related to sea level rise, marsh accretion rates, and the nitrogen removal capacity of the freshwater tidal marsh within the refuge. Continuing to support this needed research will help develop baseline data necessary for tracking the long-term trends in the hydrogeomorphology and vegetation composition of the marsh.

Setting up long-term monitoring stations within the refuge will be critical to the ongoing protection of Tinicum Marsh. We are working with the Academy of Natural Sciences and the Partnership for the Delaware Estuary to monitor parameters related to sea level rise, marsh accretion rates, and the nitrogen removal capacity of the freshwater tidal marsh within the refuge. These researchers are establishing SETs at various locations on the refuge.

SETs measure changes in marsh elevation at the millimeter scale, on an annual, and in some cases, seasonal basis. This level of precision is required to track very slow accretion or subsidence rates over time. Installation of marker horizons at SETs helps to differentiate if subsidence or accretion is most impacting marsh elevation changes. Establishment of high-quality, permanent elevation benchmarks, at or near SETs, as mentioned above, allows tracking marsh elevation changes relative to a common vertical datum or mean sea level. SETs can be used to determine a marsh's change in elevation due to response to climate stressors such as sea level rise and non-climate stressors including management activities like prescribed burning and invasive species control.

These SETs will be incorporated into the Service's regionwide effort to monitor changes to surface elevations on refuges across the northeastern Atlantic coast. Working with all Service programs, states, and other partners we can make meaningful contributions to address tidal marsh stressors and increase marsh health and resilience. This comprehensive approach is our best opportunity to preserve existing tidal marsh habitat and to understand (and address where needed) the rate of change as sea level rises.

Although restoration of tidal marsh is a priority for the refuge, the refuge's proximity to Philadelphia International Airport may be of concern. Collisions between wildlife and aircraft are considered rare, but can be catastrophic (USDA 2010). It is important for us to work with airport management to address any potential negative effects of refuge habitat restoration on airport operations.

Strategies

Continue to:

- Provide technical support to restoration efforts upon request and to targeted projects, such as the following:
 - ✱ Tinicum Township/Long Hook Creek wildlife and riparian corridor restoration.
 - ✱ Philadelphia International Airport marsh mitigation/restoration.
- Use existing biological datasets to guide species and habitat management restoration.
- Continue annual aerial spray treatments to control 10 to 15 acres of phragmites-dominated wetlands.
- Participate in spill prevention, control, and countermeasure plans or other environmental emergency action plans as related to protection of Darby Creek, open water and tidal wetlands on refuge lands.

Upon plan approval:

- Work with Philadelphia International Airport management to conduct an assessment of wildlife hazards prior to implementing wetland restoration projects on the refuge. The assessment will evaluate potential impacts of restoration projects on airport operations and ways to mitigate any potential negative effects on the airport.
- Pursue funding for additional marsh restoration projects and complete marsh restoration as funding allows.
- Control nonnative, invasive species focused primarily on phragmites and purple loosestrife through a combination of aerial herbicide application, and spot treatments throughout the growing season when populations exceed greater than 5 percent (10 acres) areal coverage across the existing 282 acres of freshwater tidal marsh.

Within 5 years of plan approval:

- Work with the Service's Chesapeake Bay Ecological Services office to complete the restoration of a 55-acre wetland area dominated by phragmites to freshwater tidal marsh subject to daily fluctuation in tidal hydrology and dominated by a mix of native species such as pickerelweed, spatterdock, and wild rice. Restored marshes will contain a network of channels across the marsh surface that resemble the pattern, dimension, and profile of channels within reference marsh areas in order to provide foraging and nursery habitat for fish.
- Develop an assessment and prioritization list of potential freshwater tidal marsh wetland restoration projects on the refuge in accordance with the refuge's HMP and the Restoration Management Plan for the Lower Darby Creek.
- Identify and implement where feasible adaptive management strategies to minimize potential impacts of a changing climate.
- Conduct a series of inventory surveys or reviews of species and habitat use of the 145-acre impoundment and freshwater tidal marsh to evaluate benefits to wildlife of open water, managed mudflat, and tidal marsh habitats.

Within 10 years of plan approval:

- Work with partners, including the Philadelphia International Airport and Tinicum Township, to complete a study evaluating the environmental effects of restoring some (about half) of the 145-acre impoundment to freshwater tidal marsh.
- If we determine restoration is desirable, complete a restoration plan detailing the optimal size, location, and components for restoration of part of the 145-acre impoundment to freshwater tidal marsh and provide improved water control management and habitat enhancement of the remaining impoundment area. The impoundment restoration plan should address effects of potential changes in flood elevations on the impoundment's existing (or new) dikes, water control structure(s), and other structures on or near the refuge and determine if these structures need to be modified or removed.

Within 15 years of plan approval:

- If we choose to develop a restoration plan, work to obtain funding for restoration of the 145-acre impoundment. Implement restoration plan if funding is obtained.

- Implement the restoration of a 27-acre wetland area dominated by degraded floodplain forest.

Monitoring Elements

Continue to:

- Support ongoing research related to sea level rise, marsh accretion rates, and nitrogen removal capacity within tidal marsh by the Academy of Natural Sciences.

Within 5 years of plan approval:

- Monitor and adapt marsh restoration projects to address effects of climate change to the extent practical.

- Partner with local universities and regional researchers to define a baseline monitoring plan that continues monitoring of variables related to climate change impacts within the existing marsh. Utilize partners to evaluate monitoring data to verify accuracy of previous and current model results.

Within 10 years of plan approval:

- Begin to evaluate the feasibility of expanding the refuge's acquisition boundary to address rising sea level caused by climate change because much of what is currently within the refuge boundaries could be under water in the next 50 to 100 years.

Objective 1.2 Coastal Plain and Floodplain Forests

Over the next 15 years, acquire, restore, and manage up to 313 acres of forested communities (52 acres of coastal plain forest and 261 acres of floodplain forest) to provide healthy foraging and stopover habitat for migratory bird species and provide breeding habitat for the coastal plain leopard frog by maintaining a canopy dominated by native trees, increasing native understory shrub and sapling cover by 10 percent, and at least a 15 percent reduction in areal coverage of herbaceous, invasive species as compared to levels inventoried in 2005.

Rationale

Coastal plain and floodplain forests provide important habitat for migrating passerine species. The Atlantic coastal plain in Pennsylvania was historically found only in a 1 to 5 milewide strip along the lower 50 miles of the State's Delaware River frontage. The coastal plain and floodplain forest types covered a significant portion of Philadelphia, supporting a suite of species common to forests further south (PNHP 2008). Focal species of concern identified for this habitat within the HMP (appendix C) include northern oriole, prothonotary warbler, wood thrush, and worm-eating warbler. Other associated species such as the Swainson's warbler, cerulean warbler, Kentucky warbler, Acadian flycatcher, and yellow-throated vireo, are all primarily associated with forested wetlands and have high concern scores within the Mid-Atlantic Coastal Plain (PIF 1999).

The prothonotary warbler and other landbirds utilize mature deciduous floodplain, riverine, and swamp forests primarily for migratory stopover and foraging habitat at the refuge (DeGraaf et al. 1980, Christman 1984). Although this species will utilize the drier portion of the forested wetland gradient, flooded habitats have been shown elsewhere to be preferred and of higher quality (Petit and Petit 1996). Prothonotary warblers are secondary cavity nesters and a good indicator species for permanently flooded forested wetlands. Prothonotary warblers are widespread throughout the extensive swamps and riverine forested wetlands within the Mid-Atlantic region (PIF 1999). However, these habitats are largely unrepresented in this portion of Pennsylvania and along the Delaware River. Regional conservation plans developed by Partners in Flight (PIF 1999) and the Atlantic Coast Joint Venture (USFWS 2008) both emphasize the need

Wood Thrush



Bill Thompson/USFWS

for inventory and monitoring of nesting sites for forested wetland nesting species such as prothonotary warbler, wood thrush, and worm-eating warbler.

The coastal plain forest also supports the single nest location for bald eagles on the refuge. The refuge is identified on a list of bald eagle watching sites in Pennsylvania and the successful breeding pair has drawn wide media attention to the refuge. Given that the breeding territory size of eagles ranges between 1,700 and 5,300 acres (Gerrard et al. 1992, Anthony et al. 1993), we do not anticipate any additional nesting pairs of eagles to be found on the refuge. However, the existing coastal plain and floodplain forest continue to provide a visual and acoustic buffer for the successful breeding pair currently on site.

Species associated primarily with other habitats for foraging also use forested areas for nest sites. For example, bald eagles (primarily associated with the impoundment and Darby Creek habitat) require forested areas for nesting sites. Since these forest communities provide diverse habitat for a variety of landbirds, reptiles, amphibians, and small mammals, providing a mixed age stand including natural tree regeneration, primary and secondary canopy, as well as a shrub and herbaceous understory, will help maximize the biological potential available on the refuge for the species that stopover during migration or breed within this habitat type.

Under this plan, we will begin large-scale restoration of the 15-acre forest area currently dominated by the nonnative gray poplar. We will clear canopy trees, control re-sprout saplings, and plant an assemblage of canopy species typical of other coastal plain forests found on the refuge, such as pin oak and sweetgum. We will also allow grasslands that are too small to provide breeding habitat for species of regional conservation concern to transition to coastal plain and floodplain forest. These areas will be contiguous with surrounding rare forests of similar type, thereby maintaining connectivity. Forested habitats also require less maintenance than early successional habitats (like grassland and shrubland) once restored. We do not anticipate a mature forest development over the 15-year life of this CCP. Instead, we aim at creating an early successional forest habitat in transition to eventually becoming a mature coastal plain forest.

One of the most critical habitat components within forested ecosystems is a well-developed forest structure including canopy trees, sub-canopy trees, understory

shrubs, and a diverse ground cover. These structural components provide numerous feeding opportunities as well as protective cover to escape predation. Much of this natural structure has been severely altered within John Heinz NWR as a result of excessive deer browse as documented in the Restoration Management Plan for Lower Darby Creek (Salas et al. 2006) and more recently in the draft deer management plan (D'Angelo 2012). The impacts of deer on forest ecosystems and their habitat components has been well documented, including their status, trend, and impact within Pennsylvania (Latham et al. 2005). Long-term preservation of nesting habitat, conservation of high-quality habitat, and restoration of degraded areas will not be feasible with continued impacts of an unsustainable deer population.

Reduction of plant species diversity and richness is a commonly noted effect of deer overpopulation. On long affected sites, the establishment and dominance of browse resilient species often is the result. Consequently, deer browse can have a measured effect on the balance between native and introduced species. Studies have repeatedly shown that deer avoid nonnative species such as garlic mustard, Eurasian honeysuckle, Japanese barberry, and tree-of-heaven if other sources of food are available (Latham et al. 2005). Deer abundance also alters ecosystem structure by reducing densities of understory trees and eliminating shrubs. Research in central Pennsylvania indicated that the occurrence of canopy gaps increased by 41 percent on lands where deer control efforts were prohibited as compared to State lands where control efforts were undertaken (Pederson and Wallis 2004).

The adverse effects of excessive deer browse are not limited to plant species. It can also alter ecosystems to the extent that they become unfavorable habitats for other wildlife. Gray squirrel, white-footed mouse, and some amphibian species have been shown to decline in areas highly browsed by deer (Elliot 1978, Nixon and Hanson 1987). Subsequently, predators of these species, i.e., owls, hawks and other carnivores, decline (Flowerdew and Elwood 2001). At a site in Virginia, a reduction in forest plant species densities also leads to increased nest predation and lower bird abundance (Leimgruber et al. 1994). These results were reinforced by a study of songbird and deer population relationships in British Columbia that found a 93 percent decrease in bird species dependent on understory vegetation (Allombert et al. 2005).

In addition to impacts of overabundant deer on refuge wildlife, high deer populations may also increase the prevalence of the Lyme disease-bearing deer tick. This concern is discussed in more detail in the section on wildlife diseases included in chapter 3.

Refuge biologists have been conducting deer population inventories for more than 10 years. These surveys involve counting deer that are driven systematically from various portions of the refuge. The results of refuge surveys have consistently recorded population numbers in the range of 60 deer per square mile. Forward Looking Infrared counts completed by USDA Division of Wildlife Services generally confirmed similar population densities on the refuge in 2009. By comparison, a deer and songbird population relationship study in northwestern Pennsylvania concluded that the threshold level for negative effects on songbird richness was between 20 and 38 deer per square mile (deCalesta 1994).

In partnership with the USDA Division of Wildlife Services, refuge biologists are currently finalizing the deer management plan. This plan will inventory and evaluate the level of deer browse pressure on the refuge habitats and develop population management recommendations based on measurable results from browse surveys and vegetation transects. This plan guides deer management

based on actual impacts to refuge habitats, rather than attempting to achieve an arbitrary density estimates (i.e., deer per square mile or set number of individuals) (D'Angelo 2012). We will reduce the deer herd over the course of several years to a level that will allow adequate regeneration of native plants and benefit the habitat and other wildlife on the refuge. We will use wildlife control specialists to control the deer population. Other land managers throughout the Philadelphia area have used similar specialists to successfully reduce and manage deer populations, most notably, the Fairmount Park Commission and Valley Forge National Historical Park.

As part of the deer management plan, fenced vegetation plots that exclude white-tailed deer are incorporated into long-term monitoring. These plots will be used to gauge the potential for natural forest regeneration when browsing by deer is suppressed. Fenced plots will be paired with nearby unfenced plots.

Most invasive plants reduce the availability and quality of native habitats, and these can have major impacts on priority bird species (USFWS 2008). The Restoration Management Plan for Lower Darby Creek documented extensive invasive species populations within the coastal plain and floodplain forest ecosystems (Salas et al. 2006). Multiflora rose, garlic mustard, Japanese honeysuckle, Japanese stiltgrass, and mile-a-minute vine are the most common invasive plant species found throughout forested habitats (Salas et al. 2006). An abundance of invasive species can result in reduced biodiversity and poor habitat quality. Invasive herbaceous and vine species can dominate the forest understory and prevent or inhibit tree and shrub regeneration. Many floodplain forest restoration projects in and around the Delaware Valley have not been successful at restoring this habitat type due to competition by nonnative, invasive species (PNHP 2008). Oriental bittersweet, Japanese hops, Japanese knotweed, Chinese wisteria, and bush honeysuckle are also major invasive species in this habitat at John Heinz NWR. In a few cases, some native birds of concern, including northern saw whet owls, have benefited from the cover provided by entanglements of invasive vines including Oriental bittersweet and Japanese honeysuckle.

A portion of the floodplain forest located in the southeastern portion of the refuge is dominated by a hybridized, nonnative gray poplar (*Populus x canescens* or *alba*). This 15-acre area also contains other nonnative species including wineberry (*Rubus phoenicolasius*) and the invasive annual mile-a-minute vine. Regeneration within this portion of forest is dominated by new sprouts of gray poplar within canopy gaps. Surrounding forests are dominated by native coastal plain and floodplain forest species such as pin oak, wild black cherry, sweetgum, and green ash; however, these species have historically been unable to compete with the nonnative and fast growing poplar species.

Strategies

Continue to:

- Reforest naturally occurring canopy gaps within the 15-acre stand of nonnative poplar with native tree species.
- Install occasional tree plantings to close canopy gaps and supplement poor regeneration due to deer browse pressure. Protect saplings with individual deer exclosures to minimize browse and decrease associated tree mortality.
- Finalize the deer management plan drafted by USDA Division of Wildlife Services.

- Restrict public access to eagle nesting areas during the breeding season and limit public access to areas of the refuge used by other rare species during their breeding seasons as needed.

Within 5 years of plan approval:

- Reduce and then maintain resident deer populations through the use of wildlife control specialists, based on recommendations of the finalized deer management plan, to reduce deer population densities, improve the available deer habitat, improve tree regeneration, and reduce potential conflicts with human populations (e.g., risk of deer/vehicle collisions). Monitor regeneration for density, plant richness, and diversity within established monitoring plots.
- Adapt long-term management plan for forest habitats to create mixed-age stands of hardwood species identified as primary components of coastal plain and floodplain target communities.

Within 10 years of plan approval:

- Initiate phased restoration of 15 acres of nonnative, poplar-dominated forest to establish a successional trajectory towards coastal plain and/or floodplain forest communities containing biological diversity and integrity similar to other forest habitats existing on the refuge.
- Restore at least 8.3 acres of existing cool-season grasslands to at least 50 percent cover by coastal plain forest species (7.7 acres near the 10-acre marsh restoration site and an additional 0.6 acres of the grasslands restored as part of the oil spill wetland mitigation site).

Monitoring Elements

- Continue to monitor deer browse impacts using USDA Animal and Plant Health Inspection Service protocols to help adaptively manage deer population control efforts.

**Objective 1.3
Darby Creek**

Over the next 15 years, manage on-refuge inputs to Darby Creek to reduce contaminants, reduce stormwater impacts from the refuge, and provide spawning, nursery, foraging, and cover habitat for anadromous (e.g., herring, alewife) and catadromous (e.g., American eel) fish populations and other Federal trust species.

Rationale

Tidal portions of Darby Creek, in combination with freshwater tidal marsh, provide a unique and productive habitat for many fish species. Some estuarine species, such as killifishes and mummichogs (*Fundulus spp.*) complete their entire life cycle in estuarine portions of rivers, creek, and tidal marshes. Anadromous fish, such as the blueback herring and alewife, use tidal streams and rivers like Darby Creek and its side channels as nursery habitat for juveniles (Odum et al. 1984). American eel, the only catadromous fish species in Atlantic Coast estuaries, spends most of its adult life in freshwater and are common in tidal creeks, rivers, and marsh channels (Lippson et al. 1979). Waterfowl like the American black duck, lesser scaup, and northern pintail as well as shorebirds like black-bellied plover, greater yellowlegs, and semipalmated sandpiper also utilize open water habitats along Darby Creek for migratory stopovers. These species are all noted as high management priorities in plans such as Mid-Atlantic Coast Bird Conservation Region Plan (USFWS 2008a), the Service's Birds of Conservation Concern list (USFWS 2008b), and Pennsylvania's Wildlife Action Plan (PGC and PFBC 2008). Thus, improving water quality and restoring suitable channel morphology where possible is critical to maintaining healthy biological

integrity, diversity, and environmental health parameters that support fish and bird species.

The National Fish Habitat Action Plan outlines several management strategies that can help guide aquatic habitat management on the refuge, as well as connecting habitats both up and downstream (NFHAP 2006). Restoration efforts by local and regional organizations within the Darby Creek watershed support components of Strategy 2 of the National Fish Habitat Action Plan (restoring natural flow and habitat variability to streams and rivers). Dam removal and other fish barrier removal efforts along Darby Creek support Strategy 3 (reconnecting fragmented river systems and spawning and nursery habitats). While these efforts are mainly located beyond the boundaries of John Heinz NWR, Strategy 3 can be supported at the refuge by freshwater tidal marsh restoration efforts that incorporate the development of shallow, sinuous, marsh surface channels that support spawning and nursery habitat for estuarine and freshwater fish species.

As previously described in detail in chapter 3, section 3.7, water quality within the refuge is a highly variable and complex phenomenon. Due to the complexity and regional scale of these water quality impacts, there is little that can be done to alleviate these concerns through management on the refuge. However, John Heinz NWR can play an active role in coordination and technical assistance toward efforts that result in improved water quality on and off the refuge. The geographic location of the refuge at the base of the Darby Creek watershed and near the Delaware River, make it an ideal location for environmental education and interpretation of watershed-based impacts to the refuge, fish, and wildlife.

Given the relative stability of the channel itself, and available habitat provided by adjacent marsh channels, overhanging vegetation, and large woody structure, the largest management concerns are related to the water quality and environmental health of waters entering the refuge. Much of the management related to Darby Creek at the refuge level relates to prevention, response, and monitoring. Given the potential for hazardous spills from neighboring roads, trains, tank farms, industrial sites, and communities, refuge staff annually reviews and updates the refuge's spill response and coordination plans. Under this plan, we will continue to support the variety of ongoing efforts to monitor basic water quality parameters within Darby Creek.

We will continue to implement best management practices, such as adhering to instructional labels when applying herbicides, to protect against potential contamination of the tidal rivers and other open tidal waters that could be impacted by refuge management activities.

We will also install water quality monitoring equipment along Darby Creek within the refuge. To date, it has been difficult to adequately gather and analyze the variety of data sets collected by agencies and volunteer-based monitoring groups. Improved and automated collection of long-term data will inform our refuge biologist on changes in long-term trends, timing (and potential affects) of acute changes in water quality, and long-term trends in salinity.

Strategies

Continue to:

- Maintain existing partnerships to assess and manage for water quality improvements impacting the refuge.
- Coordinate with USEPA and other stakeholders to complete remediation of Folcroft and Clearview landfills and minimize environmental health impacts related to contaminants associated with these sites.

- Annually, review and refresh staff in spill response protocols and emergency protection measures.
- Assist Chesapeake Bay Ecological Services office in coordinating and providing technical assistance to fish passage, stream, and riparian restoration projects within the Darby Creek watershed that have potential to increase available habitat for species utilizing the refuge or improvements to water quality.

Over the life of the plan:

- Where feasible, install stormwater management systems, such as vegetated swales or rain gardens to minimize stormwater runoff from the refuge and surrounding lands.

Monitoring Elements

Continue to:

- Support volunteer-based water quality monitoring along Darby Creek on the refuge as resources allow.
- Support of occasional and ongoing research to evaluate fish tissue surveys, contaminant level accumulation, and other environmental impacts of environmental hazards.
- Complete installation of a water quality monitoring unit along Darby Creek on the refuge to implement long-term and continuous monitoring.

Within 5 years of plan approval:

- Install a network of water quality monitoring equipment along Darby Creek on the refuge to implement long-term and continuous monitoring of salinity, dissolved oxygen, pH, temperature, flow rate, and other parameters.

GOAL 2.

Contribute to the enhancement of native species diversity in the Delaware Estuary, including migratory birds and other species of conservation concern, within the refuge's managed open waters and grasslands.

**Objective 2.1
145-Acre Impoundment and
Nontidal Open Waters**

Restore about half (78 acres) of the 145-acre impoundment to freshwater tidal marsh and manage the remaining 67-acre impoundment and 57 acres of nontidal open water (ponds) to enhance habitat available for shorebirds, waterfowl, and wading birds during their peak spring and fall migration periods, while maintaining essential habitat for other freshwater species of management concern, such as eastern redbelly turtles, through a combination of water level management, wetland restoration, and invasive species control.

To the extent practicable, these measures will include:

- (1) Annually support migratory shorebirds by maintaining a mix of shallow water (less than 6 inches water depth), mudflat with sparse vegetation less than 10 percent cover), and mudflats with no vegetation, at times of peak migration (spring: May, and fall: mid-August to September).
- (2) Annually support migratory waterfowl by maintaining a mix of shallow (6 to 24 inches water depth) flooded vegetation (*Carex*, *Polygonum*, *Peltandra*) at times of peak migration (spring: late March, and fall: late October).
- (3) Annually support migratory wading birds by maintaining a mix of shallow remnant pools (6 to 12 inches water depth) at times of peak migration (spring: late March, and fall: late August).

- (4) Sustain State-threatened eastern redbelly turtle by protecting hibernation, foraging, basking, and nesting habitat.

Rationale

As discussed in chapter 3, section 3.12 under *Impoundment and Nontidal Open Waters*, over the past several years the Service has participated in an impoundment study, managing the water levels within the impoundment to benefit migratory waterfowl, wading birds, and shorebirds with successful results (Green et al. 2008, Phillips personal communication 2008). It appears that the timed management developed as part of the study has been successful in supporting diverse bird population use of the impoundment area (Green et al. 2008, Phillips personal communication 2008). Draft results indicate that this management should be continued.

Management of the impoundment requires an adaptive approach to reduce, control, or eliminate undesirable plant species such as the invasive, nonnative purple loosestrife and the aggressive, native spatterdock, while at the same time promoting the germination of seed producing vegetation such as smartweeds and providing mudflats for benthic invertebrates. In some years, it is anticipated that the annual water level management objectives will likely require some variation from the timing most beneficial for migratory birds. To maintain extensive mudflats, annual vegetation, and shallow pools, the impoundment may occasionally require extensive inundation to prevent long-term establishment of perennial invasive species, such as purple loosestrife.

Extended inundation periods should be employed when the presence of invasive species becomes larger than feasible for control through herbicide applications. The threshold for this type of management action will be when the impoundment begins to support approximately 10 acres (7 percent) coverage of a nearly monotypic population of invasive nonnative or aggressive native species.

When timed well, this intensive form of water level management can produce beneficial habitat for a wide range of migratory and resident species of birds, reptiles, and amphibians. Unfortunately, as discussed in chapter 3, water level management of the 145-acre impoundment is currently difficult.

For this reason, under this plan, we will restore about half of the 145-acre impoundment to freshwater tidal marsh in an effort to reduce overall impoundment management and maintenance, restore additional acres of a priority habitat type, and provide improved access to this habitat for educational and interpretive purposes. Given the complexities of marsh restoration and impoundment management, the size, type, location, and cost of such restoration is unknown at this time.

Biologists have questioned how much impact the water level management has on actual bird population versus perceived populations. While the three-year impoundment study did indicate an increase in bird populations within the impoundment during migration, there were no corresponding control surveys conducted within the adjacent freshwater tidal marsh (Phillips personal communication 2010). The increase in use observed may actually be the result of birds favoring the impoundment over use of the freshwater tidal marsh during the drawdowns, which will cause a corresponding decrease within the freshwater tidal marsh.

In addition, the impoundment provides habitat for other species of conservation concern, for example the State-listed eastern redbelly turtle. It is also possible that nonnative invasive aquatic crayfishes, which represent a significant threat to the refuge's aquatic systems, occur within the refuge (Urban 2012 personal communication). Management actions, including the removal of dams and other

blockages may cause the dispersal of nonnative crayfishes, potentially allowing them to invade new areas. Therefore, we will complete a survey and analysis of both habitats to better inform the extent and location of marsh restoration within the impoundment.

The other open water areas (the 5-acre Hoys Pond and the 16-acre pond) will not be managed. These areas consist of several isolated water bodies located near I-95. Due to the shallow open water habitat, lack of species of conservation concern, and biological isolation (each pond is surrounded by heavily traveled secondary roads); we will not invest resources into long-term management of these areas. We will complete a series of inventories and evaluations related to priority species, such as the red-bellied turtle, to better inform long-term management of these areas.

Strategies

Continue to:

- Control invasive species impacting the impoundment and nearby open water habitats as feasible. Purple loosestrife (*Lythrum salicaria*) and phragmites when they spread over 5 percent (7 acres) of areal coverage across the impoundment. The aggressive native species—spatterdock (*Nuphar lutea*) when it spreads across greater than 10 percent (14 acres) of areal coverage. Control through a combination of herbicide application, mechanical controls, and water level manipulation treatments where feasible.
- Attempt management of impoundment water levels as conditions allow maximizing benefits to migrating shorebirds, waterfowl, waterbirds, and wading birds during each group's peak migration periods. Adjust drawdown timing and duration to control nonnative, invasive species when herbicide applications become a less effective option against larger populations.
- Maintain existing dike system to prevent and minimize structural damage sustained to access roads and dikes by flood events and muskrat nesting burrows.
- Close the water control structure into the impoundment during forecasted storm events to minimize stormwater runoff and pollution inputs.
- Partner with Tinicum Township to manage stormwater inputs into the impoundment and open waters along Long Hook Creek.
- Work with partners to identify and obtain resources to replace the water control system in the impoundment.
- Maintain existing wood duck and swallow nesting boxes primarily through volunteer assistance.

Within 5 years of plan approval:

- Begin to phase out some of the wood duck and swallow nesting boxes. Better monitor and manage a minimum number of boxes in a few locations as determined by the refuge manager for interpretive purposes.
- Conduct a series of inventory surveys or reviews of species and habitat use of the 145-acre impoundment and freshwater tidal marsh to evaluate benefits to wildlife of open water, managed mudflat, and tidal marsh habitats.
- Evaluate sources and locations of stormwater drainage discharging onto refuge lands and develop improvement measures such as redirecting stormwater inputs from Philadelphia International Airport to Long Hook Creek.

Within 15 years of plan approval:

- If we decide to pursue restoration of some of the impoundment, work with partners to complete and implement a restoration plan detailing the optimal size, location, and components for restoration of part (about half) of the 145-acre impoundment to freshwater tidal marsh and provide improved water control management, habitat enhancement, and visitor facilities for the remaining impoundment area (see strategies under objective 1.1 for additional details).

Monitoring Elements

Continue to:

- Support annual State and volunteer frog monitoring.
- Monitor water quality (temperature, pH, and dissolved oxygen) and water level fluctuations within the impoundment throughout the year.
- Conduct weekly inventories and monitoring of shorebirds, waterfowl, waterbirds, and wading birds use and abundance within the impoundment during spring and fall migrations. Use data to document the ongoing effectiveness of water level management activities and adjust management protocols as necessary.
- Conduct migratory bird surveys for landbirds, waterbirds, and waterfowl.
- Complete fisheries inventory of Hoy's Pond and the 16-acre pond on refuge lands.

In addition:

- Conduct weekly inventories and monitoring of shorebirds, waterfowl, waterbirds, and wading birds use and abundance within the impoundment. Use data to determine the effectiveness of water level management activities and adjust management protocols as necessary.

Within 5 years of plan approval:

- Conduct baseline eastern redbelly turtle inventory surveys and create a long-term monitoring program within the impoundment, open water areas, and the freshwater tidal marsh to determine forage, hibernaculum, and nesting sites. Where feasible, complete inventories in partnership with local universities and state agencies.
- Explore opportunities for reducing turtle nest predation through predator trapping, predator relocating, or other measures.
- Explore coordination with PFBC for potential red-eared slider removal.

Objective 2.2
Grasslands and Early
Successional Habitats

Manage up to 64 acres of grasslands and wet meadows to create a mix of native grasses and flowering plants, including early successional shrubs and trees, to sustain stopover foraging and cover for migratory landbirds. Specifically,

- Annually, manage habitat around Frog Pond and Hoy's Pond fringe as wet meadow containing less than 15 percent areal coverage of tree and shrub species, no more than 5 percent bare ground, and at least 90 percent of the total areal cover is comprised of native species.
- Within 10 years of plan approval, restore biological diversity to the existing 7 acres of grasslands surrounding the visitor center and refuge entrance, so that at least 90 percent of the total areal cover is comprised of native species and support a minimum of seven species of native grasses, and seven species of native flowering plants.

Rationale

Grasslands were uncommon in the Northeast prior to European settlement, and grassland birds are of moderate concern in the region (USFWS 2008a). Fewer grasslands are available to birds throughout the Mid-Atlantic region as agricultural lands have been lost to commercial and residential development as well as natural succession. Today, grassland-dependent birds within the Mid-Atlantic region depend upon agricultural landscapes and other artificial habitats to maintain populations. Military installations, airports, golf courses, parks, recreational fields and other artificial and maintained grasslands also provide some modified types of this habitat today.

Until the past few decades, the upland habitats of John Heinz NWR were comprised of a substantially greater amount of grasslands than today (McCormick et al. 1970, McMenamin personal communication 2008). The Restoration Management Plan for Lower Darby Creek compared habitat coverage between those documented in the Two Studies of Tinicum Marsh (McCormick et al. 1970) and those identified as part of field inventories conducted in 2005 (Salas et al. 2006). Many forested areas along the existing dike system and within areas east and south of the 145-acre impoundment contained scattered trees (less than 10 percent cover) and “old field” vegetation in 1968, making the forested habitats of the refuge a relatively recent cover type. Additionally, historic aerial photographs reviewed as part of that plan documented a greater extent of grasslands east of the existing impoundment (Salas et al. 2006). Due to this relatively isolated and small (less than 100 acres) component of grassland, it is unlikely that the refuge ever had (or will be able to) contribute significantly to regional populations of priority grassland birds.

Today, many of these historic grasslands are covered by coastal plain or floodplain forest community types. Coastal plain and floodplain forests are the habitat type that is considered to be the late-successional forest community typical of the Pennsylvania Coastal Plain region. As a result of the urbanization of the Philadelphia area, few examples of this habitat are available in Pennsylvania, causing the State to list some of the associated community types as S3, or State-rare.

While the grasslands of John Heinz NWR are generally too small to support nesting of priority grassland species within the region, some grassland areas can provide suitable migratory stopover and foraging habitat for migratory birds. Additionally, these grasslands provide important habitat for focal species of concern such as the short-eared owl, sedge wren, marsh wren, and the coastal plain leopard frog. The southern leopard frog in particular is known to breed in some of the shallow permanent water and vernal pool habitats found within the refuge’s wet meadow grasslands (Phillips and McMenamin personal communication 2008).

Most of the grasslands existing on the refuge today are the result of managed utility right-of-ways that intersect portions of the refuge. Utility corridors transporting oil, gas, potable water, wastewater, and electricity all pass through the refuge. Utility companies are required to maintain these areas free of trees and shrubs in order to prevent damage by root growth or wind thrown trees. Maintaining these areas without tree or shrub growth also aids utility maintenance and emergency response by facilitating efficient access to the corridor when needed.

Grasslands also require a great amount of maintenance to control invasive species and reduce woody species establishment. While there is some variation in area sensitivity among grassland-dependent birds (Ribic et al. 2010), they

generally need areas greater than 25 acres for nesting, with many preferring or requiring patches greater than 75 acres (Mitchell et al. 2000, Morgan and Burger 2008).

We must maintain some of the refuge's grasslands to protect existing pipelines that will be damaged by tree or shrub roots if the area was allowed to succeed to forest. Likewise, the Folcroft Landfill area will need to remain in early successional habitat, probably grasslands, to ensure that deep-rooted trees do not compromise the integrity of the site remediation resulting in the release of contaminants. These areas also benefit from being maintained as grassland to provide access for maintenance and emergency response. Under this plan, areas where we have identified the least habitat benefit due to a combination of maintenance needs, patch size, and current species composition will be allowed to succeed to shrub or forest. We want to maintain and enhance the remaining grasslands to provide habitat diversity, breeding habitat for coastal plain leopard frog, and for environmental interpretation purposes.

As described under objective 1.2, we will allow two main areas of grassland to transition to shrub or forest: the first is 7.7 acres along the southern edge of the refuge, along I-95 near Hoy's Pond, and the second, an additional 0.6 acres of warm-season grasslands located at the location of the 2000 oil spill mitigation site on the eastern border of the impoundment. Under this plan, we will cease regular mowing and promote the conversion of these to early successional forest and scrub-shrub habitat. This change in management will reduce resources needed for management and also create an additional habitat type to support landbirds such as prothonotary warblers and short-eared owls. In addition, we will work with utilities to discuss the feasibility of converting additional grasslands along the utility right-of-ways to scrub-shrub habitat. Providing additional benefits to the landbirds mentioned above and further reducing resources needed for management.

The remaining 64 acres of grassland found within the refuge will be enhanced through a combination of invasive species control and supplemental planting or seeding. Grasslands near the refuge entrance and along right-of-ways are comprised largely of cool-season grasses such as Kentucky bluegrass, fescue, orchard grass, and brome grass. An endophyte (*Neotyphodium coenophialum*) present in the cold-season grass tall fescue (*Lolium arundinaceum*) has been shown to have detrimental effects on herbivorous species and associated ecosystems (see summary in Rudgers and Clay 2007). Under this plan, where possible, we will undertake efforts to enhance species diversity and conversion to grasslands dominated by warm-season grasses to enhance the habitat value for landbirds of conservation concern and benefit herbivorous animals such as voles and rabbits. Some areas may not be appropriate for warm-season grass enhancements due to jurisdiction or where warm-season grasses may interfere with long-term management and protection, such as Folcroft Landfill.

Strategies

Continue to:

- Annually mow to maintain the existing 72 acres of wet meadow, grassland, and forest opening habitats for wildlife, environmental education, and interpretive purposes.
- Control invasive species impacting wet meadow and grassland habitats through a combination of herbicide application, hand pulling, and mowing.
- Maintain vernal pool and wet meadows for amphibian breeding and grassland bird stopover habitat.

- Promote warm-season grass establishment in areas previously dominated by cool-season grasses.

Within 5 years of plan approval:

- Cease annual mowing of 8.3 acres of existing grasslands targeted for successional transition into a scrub-shrub dominated habitat type.
- Begin supplemental plantings within the grasslands surrounding the visitor center to enhance species diversity so that 90 percent of the total areal cover is comprised of native species and support a minimum of 7 species of native grasses, and 7 species of native flowering plants.
- Where feasible, install stormwater best management practices, such as vegetated swales or rain gardens to minimize stormwater runoff from the refuge and surrounding lands.
- Discuss feasibility of converting portions of utility right-of-ways to additional shrub-scrub habitat in light of access, maintenance requirements, and compromising infrastructure (i.e., pipelines).

Within 15 years of plan approval:

- Complete habitat management, compatible use, and public use planning for the Folcroft Landfill site within 2 years of site remediation and release.

Monitoring Elements

Annually conduct frog call surveys of known vernal pools to monitor species and their use of areas for breeding sites. Utilize data to document sensitive breeding areas and long-term effectiveness of management activities in order to adjust management protocols as necessary.

GOAL 3.

Provide a wide range of environmental educational opportunities, focusing on urban youth, which raise awareness and understanding of the Service and the National Wildlife Refuge System, inspire appreciation and stewardship of our natural and cultural resources, and expand understanding of Tinicum Marsh as a unique component of the Delaware Estuary and the local community.

Discussion

As discussed in chapters 1 and 2, environmental education is one of the original establishing purposes of John Heinz NWR. In its establishing legislation, the refuge was directed to develop "...a wildlife interpretative center for the purpose of promoting environmental education, and to afford visitors an opportunity for the study of wildlife in its natural habitat." (86 Stat. 891, dated June 30, 1972). The Refuge Improvement Act also identifies environmental education as a priority public use on refuges.

The Service policy on Priority Wildlife-dependent Recreation (605 FW 6) defines environmental education as activities that use a planned process to build knowledge, skills, and abilities in students and others, about wildlife-related environmental topics. Environmental education teaches students the history and importance of conservation and ecological principles, and scientific knowledge of our nation's natural resources. In doing so, we can help develop a citizen base that has the awareness, knowledge, attitudes, skills, motivation, and commitment to work cooperatively toward the conservation of our nation's environmental resources.

As discussed in chapter 1, section 1.5, the Service recently developed a new vision for the Refuge System. The vision, which provides guidance for the entire Refuge System over the next 10 to 15 years, was released in October 2011 (online at: <http://americaswildlife.org/vision/>). As part of its recommendations, the vision outlines an urban refuge initiative that highlights the importance and role of urban refuges in connecting with diverse audiences and a more urban population. With its natural resources, visitor facilities, and proximity to the Philadelphia metropolitan area, John Heinz NWR is well situated to help fulfill the goals for urban refuges in the Refuge System vision. It offers teachers, urban students, and other environmental education partners an opportunity to study habitat management and restoration, effects of climate change, and five different habitats including Pennsylvania's largest tidal marsh in a natural setting. The School District of Philadelphia alone manages over 280 schools and is the 8th largest school district in the United States. Over 160,000 students are enrolled in Philadelphia public schools (School District of Philadelphia 2010). Philadelphia is also one of the largest college towns in the U.S., with over 120,000 students enrolled among the 80 colleges, universities, trade, and specialty schools in the area.

As with many other states in the country, Pennsylvania has incorporated environmental education into required State curricula through the Pennsylvania Department of Education Academic Standards for Environment and Ecology. These standards describe what students should know and be able to do in the following areas: ecology, watersheds and wetlands, natural resources, agriculture and society, humans and the environment, integrated pest management, threatened, endangered, and extinct species, environmental laws and regulations, renewable and nonrenewable resources, and environmental health. John Heinz NWR, the Refuge System, and the Service can help teachers and schools meet these educational standards while raising the awareness of area students about the role of the refuge, the Refuge System, and the Service in protecting species and habitats. Students will also understand the benefits of these conservation efforts for species and society and the importance and value of the history and cultural resources on the refuge. Refuge environmental education programming should continue to incorporate science and chemistry curricula.

To encourage visitors to better understand the natural history of the area and related cultural resources, the refuge engages students in understanding cultural resources and conservation history as an introduction to environmental education lessons. No cultural or archaeological areas of significance are believed to remain on the refuge itself.

As discussed in chapter 3 section 3.14, about 9,400 students a year participate in environmental education opportunities led by their teachers or by refuge staff and volunteers. Education activities currently offered by refuge staff focus primarily on assisting teachers in developing environmental lesson plans for both onsite and offsite learning, sponsoring various onsite environmental workshops, and conducting onsite field trips for school groups. About 200 teachers a year participate in these programs. Typical audiences for existing education activities consist of School District of Philadelphia and Delaware County elementary classes, summer camps, and some interest from local college programs for sustainable architecture, landscaping, wildlife, and environmental studies. Also, see appendix H (USGS Phase 1 Environmental Education Needs Assessment) for additional information on the refuge's current environmental education program.

The study of the environment and ecology allows students to actively participate in solving real issues that affect them, their homes, their schools, and their communities. This provides a tremendous opportunity for mutually beneficial relationships between the refuge and surrounding schools. Opportunities

to support State educational standards are not limited to the study of the environment and ecology. This plan expands education programs at the refuge to incorporate subjects such as writing, math, art and history into all lesson plans. Providing refuge programming with connections to a variety of school subjects is an opportunity not only to educate, but to also inspire stewardship and connect many young people with nature who traditionally may have limited access to or experience with refuges and nature.

As staff, volunteers, and budget allow, under this plan, we expect to increase our onsite and offsite student visits from 9,400 to up to 24,000 visits, as well as maintaining our teacher training programs. To accommodate this increase, we will hire additional refuge staff and will recruit and train additional volunteers. To ensure high quality delivery of the new refuge programs, we will create a docent training program, in which volunteers are trained and evaluated with baseline competency guidelines for knowledge, skills, and abilities (examples include Philadelphia Zoo Docent Training Program and National Park Service), to provide unified and consistent programming. They would also be rewarded for their service and dedication.

There are several environmental education centers located within an hour's drive of the refuge, including the Cobbs Creek Community Environmental Education Center, Schuylkill Center for Environmental Education, Overbrook Environmental Education Center, Tyler Arboretum, and Riverbend Environmental Education Center. Our intent is to provide a site-specific education experience that focuses on the natural resources found at John Heinz NWR. To help us ensure that we are addressing target audiences and meeting the needs of environmental education participants, we initiated a study with USGS to both capture the refuge's current program (Phase I, see appendix I) and the needs of current and potential participants in the refuge's environmental education program (Phase II). The Environmental Education Stakeholder Needs Assessment Phase II report (Wells and White 2011) identifies some of the existing programs around the area, reviews demographics and potential audiences, summarizes where opportunities are available, and makes some suggestions to guide future planning. Under this plan, we will use these results to guide our future environmental education program planning, including developing new environmental education programming and completing the environmental education component of the refuge's visitor services plan.

Every national wildlife refuge is required to complete a visitor services step-down plan which will help focus visitor services efforts. Visitor services plans encompass all aspects of visitor services on the refuge, including a section on environmental education. Under this plan, the visitor services plan will identify, define, and prioritize audiences. It will also identify themed messages and topics that will apply to all environmental education and interpretation programming. Given the importance of environmental education to the refuge, and the refuge's critical role in connecting young people with nature and representing the Refuge System and the Service in an urban environment, developing and implementing a visitor services plan is particularly important at John Heinz NWR. For this reason, John Heinz NWR staff will begin writing the refuge's visitor services plan as soon as possible.

Strategies that apply to all objectives under this goal include:

- Within 2 years of CCP approval, complete the refuge's visitor services plan. This plan will: (1) specify themed messages and topics tied to refuge-specific resource conservation issues, the Refuge System mission and new vision, and the Service mission and goals, (2) be consistent among the different visitor services programs (i.e., environmental education and interpretation), and (3) identify, define, and prioritize audiences.

- Use the visitor services plan and the results of the Environmental Education Stakeholder Needs Assessment Phase II Report (Wells and White 2011) to guide the refuge's environmental education program focusing on urban schools (grades K to 12), including creating a series of lesson plans that explore the resources of the refuge that are unique to the refuge, and consistent with themed messages and topics, Expand the refuge's capacity to deliver quality environmental education programming by recruiting additional volunteers and establishing a docent training and reward program for volunteers.
- Pursue ongoing alignment of the refuge's environmental educational program with Pennsylvania State academic standards and if applicable, certifications for curricula and teacher trainings.
- If resources allow, hire two additional outreach and environmental education and interpretation staff (one will be stationed at John Heinz NWR but shared with other refuges in the Northeast Region) to help expand the environmental education program and meet the projected increase in visitation. We will also hire an additional maintenance worker to help maintain visitor facilities to support programs if resources allow (see appendix D for proposed staffing chart).
- Work with FOHR to continue funding and pursue alternative funding or grant programs if needed for supporting transportation to and from the refuge for interested and qualifying schools and groups based on the results of the Environmental Education Stakeholder Needs Assessment and actions outlined within the visitor services plan.
- Update and incorporate all appropriate media (brochures, Web site, social media, displays, etc.) to accurately communicate the environmental education components available to the public.



LaYonda Walton/USFWS

Children watching birds during a refuge interpretive program

Monitoring elements:

- Determine which schools or school districts will be defined as urban and non-urban. Monitor and record visitation by urban and non-urban schools to determine if we are reaching our target audience.
- Annually complete an evaluation summary of environmental education opportunities provided (number of programs, events, outreach efforts provided) and their utilization (number of visits, schools, teachers, and students engaged).
- Work with teachers, school administrators, and other environmental education partners to monitor and assess the efficacy of new environmental education curricula and materials. Modify the lesson plans as needed to ensure content is meeting identified priorities [i.e., curricula are (1) consistent with themed messages and topics identified in the visitor services plan (once developed), (2) relevant to urban youth, (3) staff and volunteer led, hands-on, place-based (i.e., unique to the refuge), and (4) aligned to applicable education standards.]
- Work with environmental education partners to monitor efficacy of established environmental education programs every 1 to 3 years. Monitoring efforts may include surveys developed and conducted by partners, peer observation and review, self-evaluations, verbal discussions with participants (teachers and students), record number of repeat visits (within and among years) and new participants.

Objective 3.1
Providing Environmental
Education Focusing on Youth
in Urban Schools

Over the 15-year life of the plan, provide a quality environmental education program at John Heinz NWR with specific themes and learning objectives. The environmental education program will:

- (1) Focus on urban schools (grades K to 12).
- (2) Provide a variety of programming that is site specific and relevant to the target audiences.
- (3) Meet State education standards when applicable.
- (4) Be based on refuge management and conservation programs.
- (5) Support the missions of the Service and Refuge System.
- (6) Increase student visits from urban schools to approximately 16,000 per year.
- (7) Focus on providing staff-led and volunteer-led programming.
- (8) Develop long-term relationships with students and at least three schools and respective school districts.
- (9) Provide stewardship opportunities.

Rationale (In Addition to Discussion)

John Heinz NWR is one of four refuges within the Northeast Region (of 73 refuge units) that is located within 45 miles of a major metropolitan area¹. Given

¹ The U.S. Census Bureau defines a major metropolitan area as containing a population of one million or more people.

its location partially within the city of Philadelphia and Delaware County, the refuge has the opportunity to form long-term relationships with local urban schools containing a population of students and teachers who traditionally may have had limited access to and experience with nature.

When asked, refuges identify transportation costs, transportation (i.e., bus) schedules, and school proximity to the refuge as three of the largest barriers to their ability to work with populations from urban environments (USFWS Northeast Region unpublished data). For John Heinz NWR, these barriers are significantly reduced as there are more than 300 urban public schools that serve over 146,000 students (grades K to 12) within the Philadelphia and Delaware County school district alone (Philadelphia School District 2011). Friends of Heinz Refuge also offers grants to schools to pay for busing. Given the important opportunity that John Heinz NWR has for working with students from urban settings, the refuge will focus limited staff and volunteer time towards working directly with students from urban schools (grades K to 12) through both on and offsite programming. The intention is to maintain and expand the current program and also to formulate long-term relationships with school districts that involve: (1) incorporation of refuge lesson plans into school curricula, (2) school participation in the program over many years, and (3) refuge staff working with students multiple times in a year. Repeated visits help students gain confidence with nature, foster a connection between students and the refuge, and increase the chances that students will feel a sense of stewardship towards the environment.

Since every school has different needs, refuge staff and volunteers will work with schools to design programming that meets Pennsylvania State standards of learning, covers a range of media (e.g., outdoor investigations, service projects, discovery hunts, etc.), and is relevant to the audience. One way we may be relevant to our audiences will be to connect with the lives of students, working to identify ways they can make a difference in solving problems and high priority issues within the local community. We will focus on environmental education programming at the refuge but will use offsite programs to develop long-term relationships with urban schools. In addition, this programming will be designed in accordance with the visitor services plan with well defined themes and topics, and with an evaluation system in place. All programming will complement the missions of the Service and Refuge System, and speak to refuge management strategies.

Strategies

In addition to the strategies presented above under strategies that apply to all objectives:

Within 7 years of plan approval:

- Maintain relationships and programming with area schools that currently visit the refuge for environmental education.
- Offer at least 12 workshops annually that focus on teaching teachers how to implement refuge environmental education programs so interested teachers are provided an opportunity to lead their own classes on the refuge.
- Work with local teachers, school administrators, and other environmental education partners to develop additional lesson plans that will enhance environmental education programs that are (1) consistent with themed messages and topics identified in the visitor services plan (once completed), (2) targeted towards urban schools and relevant to urban youth, (3) led by

refuge staff or trained volunteers and hands-on, place-based (i.e., unique to the refuge), and (4) aligned to applicable education standards.

- Review and evaluate existing components (e.g., Habitats of the Refuge, Birds of a Feather, Peoples Interaction with the Environment, teacher education courses, Microlife) of the environmental education program to determine if they meet the specific criteria identified under this objective and are effective. Modify, add, or eliminate components as needed.
- Identify local urban schools and school districts that meet our definition of targeted audiences and create a prioritized list of at least 15 of these schools.
- Use our relationship with the Interboro School District in Delaware County as a model to help develop long-term relationships with at least three additional local urban school systems from our prioritized list. A long-term relationship could include formal adoption of refuge programs into the school districts' curricula, repeated visits of refuge staff to the school, and repeated visits of students to the refuge both within the academic year and in subsequent years.
- Expand use of alternative funding or grant programs for transportation to and from the refuge for schools based on the results of the Environmental Education Stakeholder Needs Assessment Phase II Report and actions outlined within the visitor services plan.
- Have refuge staff or trained volunteers lead 200 student-focused programs per year both on and offsite, totaling about 12,000 student visits per year.

Within 15 years of plan approval:

- Continue to develop and expand course lesson plans in cooperation with local teachers, school administrators, and other environmental education partners.
- Expand long-term relationships with local schools to at least three more urban schools.
- Have staff and trained volunteers lead 275 student-focused programs per year both on and offsite, totaling about 16,000 student visits per year.

Monitoring Elements

- Work with teachers, school administrators, and other environmental education partners to annually monitor efficacy of established environmental education programs targeting urban youth. Monitoring efforts may include surveys developed and conducted by partners, peer observation and review, self-evaluations, verbal discussions with participants (teachers and students), record number of repeat visits (within and among years) and new participants.
- After new programs have been in place for 3 years, assess feasibility of developing an official Service survey to evaluate effectiveness of programs.

Objective 3.2 Environmental Education for Other Youth Audiences

Over the 15-year life of the plan, provide a quality environmental education program at John Heinz NWR with specific themes and learning objectives. The environmental education program will:

- Include programs for other youth audiences, for example home schooled students, 4H, YMCA, SeaGrant, Boy Scouts, Girl Scouts, college students, and other nonprofit youth organizations.
- Increase student participation in refuge programs by these groups to 8,000 student visits per year.

- Focus on providing teacher and group leader education.
- Provide a variety of programming that is site specific and relevant to the audiences.
- Meet State education standards.
- Be based on refuge management and conservation programs.
- Support the missions of the Service and Refuge System.
- Provide stewardship opportunities.

Rationale (in addition to the Discussion)

While our focus is on youth in urban schools, we recognize the importance and value of providing environmental education opportunities to all interested partners. Refuge neighbors and partners are crucial to helping the refuge and the Service meet conservation goals. We would like to support these groups in their environmental education efforts. Participants under this objective will include a variety of groups such as: students that are from outside of the local urban area, non-traditional K to 12 students (e.g., home-schooled students), participants in non-formal education programs (e.g., Boy Scouts, Girl Scouts), college-level students, and education providers for these groups. Because refuge resources are limited and much of the staff and volunteer time will be focused on priority urban youth audiences, environmental education programming for other youth audiences will focus on more teacher-led programs with less direct involvement from staff and trained volunteers. Ultimately, our goal will be for most educators of these audiences to independently lead refuge programming or their own program (provided it incorporates appropriate refuge themes as identified in the visitor services plan and refuge-specific content) with minimal input from staff. When staff time and other resources allow, refuge staff and volunteers will work directly with these audiences.

To support teachers' environmental education efforts within their classrooms, the refuge will expand on available teaching materials and loan boxes offered to schools. School budgets are often restricted and materials that teachers can borrow which teach about local environmental concerns and about the refuge make it easier for teachers to implement environmental education into their curricula. Lesson plans developed to reach priority urban youth will also be made available for these other youth audiences.

Strategies

In addition to the strategies presented above under strategies that apply to all objectives, we will continue to:

- Provide educational activities, curriculum, and other appropriate resources on the refuge Web site.
- Continue to offer at least 12 workshops annually that focus on teaching teachers how to implement refuge environmental education programs so that education providers can lead programs on the refuge.

Within 7 years of plan approval:

- Work with teachers, university professors, academic administrators, and other environmental education partners to expand the teachers workshops to include additional programming based on the results of the Environmental Education Stakeholder Needs Assessment and actions outlined within the visitor services plan (e.g., additional college-level programs).

- Evaluate and modify or expand, if appropriate, loan boxes and teaching equipment and supplies.
- Review and evaluate existing components (e.g., teach the teacher workshops, Microlife) of the environmental education program to determine if they meet the specific criteria identified under this objective and in the visitor services plan and are effective. Modify or eliminate components as needed.

Within 15 years of plan approval:

- Develop a set of days dedicated to programming for less formal youth organizations (i.e., not traditional school groups).
- Formalize partnerships with youth organizations such as Big Brother Big Sister Program, 4H, YMCA, SeaGrant, Boy Scouts, Girl Scouts, college students, and other nonprofit youth organizations that are not already covered by national agreements.

Monitoring Elements

Same as monitoring elements under strategies that apply to all objectives under this goal.

GOAL 4.

Visitors, students, and local residents of all ages and abilities enjoy their refuge experience, understand and appreciate the refuge's natural and cultural resources and its contribution to conserving those resources in the Delaware Estuary, and are inspired to become better stewards in their everyday lives.

**Objective 4.1
Environmental Interpretation**

Over the life of the plan, expand on and offsite environmental interpretation opportunities through updating refuge infrastructure and developing electronic media for up to 35,600 visitors, students, and area residents that emphasize the refuge's natural and cultural resources and its contribution to conserving those resources in the Delaware Estuary and enhance the infrastructure and facilities necessary to provide a quality interpretive experience.

Rationale

The Refuge Improvement Act identifies environmental interpretation as one of the six priority public uses. Environmental interpretation includes activities, talks, publications, events, programs, audio-visual media, signs, and exhibits that convey key messages about natural and cultural resources to visitors, but that do not address a specific educational curriculum requirement. It provides opportunities for visitors to make their own connections to nature and wildlife, which invites participation in resource stewardship and helps refuge visitors understand their relationships to, and impacts on, those resources.

With over 35 million people within a 2-hour drive, the refuge lies within one of the most densely populated areas of the nation. Being located in such a high density, urban area with many recreational options, the refuge can easily be overlooked. Life-long residents located near the refuge report never having known about the refuge prior to their first visit.

The refuge interpretive programming includes a variety of experiences that appeal to varying audiences, visitor interests, and learning styles. In addition to passive interpretation, the refuge offers several interpretive events annually such as the Cradle of Birding Festival, National Refuge Week events, and Pennsylvania's division of the Federal Duck Stamp competition. Refuge staff and volunteers also participate in a variety of interpretive programs with partnering organizations such as scout troops, the YMCA, and the Audubon Society.

In early spring of 2010, the refuge was home to its first-ever recorded pair of bald eagle chicks. This successful breeding of bald eagles at this highly urban refuge provides a unique opportunity for interpreting the importance of conservation. The hatching of these chicks was nationally recognized online, on television, and in newspapers including the Philadelphia Inquirer, the Washington Post, and the Kansas City Star. To expand the interpretive opportunities associated with the eagles, the refuge is currently implementing plans to install a Web cam near the nest site to allow the public to view the eagles up close and without disturbance via the internet.

Under this plan, we will build upon our existing programs to make upgrades in interpretive infrastructure necessary to improve accessibility and utilize newer technologies to convey our interpretive goals. Providing an array of options for engaging visitors in interpretive programs and events is critical to increasing refuge visitation and expanding participation in resource stewardship and protection. It also achieves a national Service priority which is connecting children with nature.

We will expand upon our existing mix of guided interpretive tools, Service-sponsored events (such as the Cradle of Birding Festival and National Wildlife Refuge Week), and partner-sponsored events to increase annual participation from its current level (13,300 participants in 2009) up to 26,000 participants within 15 years of plan approval. We hope to improve the amount of off-season visitation (November through early March) to the refuge by providing programs and events that target young families and will encourage connecting youth with nature. By inviting visitation through off-season interpretive events, we can showcase the seasonal variation of the refuge and encourage repeated visitation throughout the year.

We hope to increase the amount of offsite participation in environmental interpretation to about 9,600 participants. New Web-based programs combined with additional partnerships will help us reach these additional goals.

Improving the quality self-guided services, signs, and facilities will also enable us to reach a larger audience, be more readily available, and allow visitors to use them at their own pace, while still initiating discussion and providing answers to questions.

Improving interpretation of Tinicum Marsh is another focus of this plan. By constructing additional infrastructure in the form of boardwalks, bridges, and observation areas, we can improve access and visibility of the marsh areas existing and proposed for restoration. When coupled with the addition of digital technology, such as a cellular phone tour or podcast, we will open a broad array of new interpretive options for visitors.

Strategies

Continue to:

- Maintain existing publications, access points and infrastructure, including trails, parking, and interpretive exhibits, kiosks, printed materials, and signage.
- Host environmental art displays at the visitor center as opportunities arise.
- Maintain ongoing updates to the refuge Web site.
- Annually, host at least 100 volunteer-led nature walks and programs, for example regular bird and plant walks.

- Provide programs and camps designed specifically for families and youth including: Through the Lens, MicroLife, Wildlife Photography Summer Camp, and a Birding and Fishing Summer Camp.
- Annually, host at least six conservation-oriented or wildlife-dependent interpretive events.
- Annually, conduct at least five offsite environmental interpretation programs.
- Work with partners and volunteers to develop and present onsite and offsite programs for non-school audiences, such as families, libraries, festivals, and scout groups that support the mission and goals of the Service.
- Complete the redevelopment of the existing example backyard habitat.
- Complete installation of the Web cam at the eagle's nest.
- Promote and participate in Service initiatives such as the National Junior Duck Stamp Program, Nature Champions, Urban Youth Initiative, and Project Bud Burst.

Within 2 years of plan approval:

- Identify key user groups utilizing the refuge and compile a targeted list of associated organizations, businesses, and affiliations potentially interested in learning more about the refuge through interpretive events and programs.
- Improve directional trail, regulatory, and interpretive signage, including development of a formalized entrance along SR 420 and improve directional signage to the refuge.
- Develop new day camp programs and expand the number of day camps offered to at least 12 per year.

Within 5 years of plan approval:

- Complete the refuge's visitor services plan, including an environmental interpretation component. This will specify themed messages that will be consistent among the different programs and will prioritize audiences. Themes will describe refuge management and its relationship to habitats and wildlife and will include larger-scale concepts such as climate change and green building.
- Develop events and programs tailored to targeted audiences incorporating themes from the visitor services plan. Host these events between November and May to encourage use in these slower months.
- Reorient existing displays and expand exhibits in a way that promotes exploration and longer viewing time by visitors.
- Develop at least two interpretive materials (e.g., bilingual signs and brochures) in other languages (e.g., Spanish) to help increase our effectiveness at reaching out to non-English speaking audiences.
- Develop at least three interpretive materials and programs specifically designed for people with disabilities including activities such as guided bird song tours of the refuge, signs and brochures in braille.

- Update all refuge displays, kiosks, signage, and trail system to support a more digital interpretive infrastructure applicable to urban youth and technology-ready visitors. Possibilities include the following:
 - ✱ Providing at least three tools available via the Web such as podcasts, virtual tours, and interactive programs.
 - ✱ Developing a cellular phone-based interactive trail.
 - ✱ Updating refuge-orientation DVD.
 - ✱ Creating an interactive flyover exhibit to explore the habitats of the refuge.
- Pursue additional alternative funding or grant programs for supporting transportation to and from the refuge for interested and qualifying groups based on actions outlined within the visitor services plan.

Within 10 years of plan approval:

- Work with the USEPA to develop an interpretive plan for the Folcroft Landfill including public use features such as an interpretive trail system, observation tower, and pedestrian bridge to develop access to upon site release.
- Create more interactive exhibits suitable for younger visitors (2 to 8 years old).
- Develop easily updated displays related to the various habitats found across the refuge.
- Improve access to and interpretation of Tinicum Marsh utilizing methods that provide access while minimizing visitor impacts to the marsh and wildlife using the marsh through new interpretive infrastructural measures such as boardwalks, wildlife viewing blinds, and bridges.
- Develop a series of programs and travelling exhibits on specific topics targeted to particular groups and events. Work with group leaders to develop environmental education programs that are hands-on, place-based, and aligned with applicable education standards/requirements.

Monitoring Elements

- Annually complete an evaluation summary of environmental interpretation opportunities provided (number of programs, events, outreach efforts provided) and their utilization (number of visits, number of participants engaged, and type of activity).

GOAL 5.

Provide quality, wildlife-dependent recreation that allows a diversity of visitors to connect with nature in the outdoors.

**Objective 5.1
Wildlife-dependent
Recreation**

Annually, provide visitors with wildlife-dependent recreation opportunities including fishing, wildlife observation, and nature photography, and maintain the infrastructure and facilities necessary to provide a quality experience.

Rationale

As discussed in chapter 3 section 3.14, John Heinz NWR offers shaded trails, vistas of the impoundment and tidal marsh, as well as fishing and other activities allowing people to take a break from the busy urban setting in which they work and live (VanBeusichem et al. 2009). The refuge provides recreation opportunities unique to the Philadelphia area through its management for habitat protection and wildlife diversity. All refuges are encouraged to provide wildlife-dependent

recreation opportunities under the Refuge Improvement Act. This type of recreation is intended to encourage connection with nature and foster wildlife conservation and environmental stewardship. With over 120,000 visitors annually participating in some form of wildlife-dependent activity, wildlife-dependent recreation is by far the largest reason for visitation to the refuge.

Fishing is a large draw for anglers and families who visit the refuge. Panfish, largemouth bass, and striped bass are species commonly fished for on the refuge. The refuge sponsors fishing days. Also available to visitors, free of charge, is the Rod Loaner program. Sponsored by PFBC, this program allows visitors to borrow some of the basic equipment needed to fish the waters around the refuge during their visit. All of these opportunities allow for public interaction with refuge staff and volunteers while participating in a priority public use. USA Today Travel highlights the refuge as a primary fishing destination for children near Philadelphia (Russell 2010). Yahoo's Associated Content Web site also highlights the refuge as the "best fishing spot in Philadelphia" (Bove 2010).

The refuge also offers several opportunities for wildlife observation and photography. These opportunities consist of both self-guided and staff and volunteer guided programs. Resources that promote self-guided wildlife observation and photography include equipment loans, photography blinds, and boardwalks and other structures outfitted with telescopes. Staff and volunteers guide regular bird and plant walks, sponsor a photography contest and traveling photo exhibit, and provide a series of programs and camps designed specifically for families and youth. These programs and camps include Through the Lens, MicroLife, and various summer camps (VanBeusichem et al. 2009).

The annual return and successful breeding of bald eagles on the refuge have generated renewed interest in the refuge and its residents. To expand upon this interest, the refuge is continuing to support its Friends group with the installation of a Web cam that will afford Web browsers the opportunity to observe the refuge wildlife at their convenience. The installation of this Webcam will create new opportunities for education and interpretation with area schools and other environmental education programs.

According to surveys conducted as part of the Pennsylvania State Comprehensive Outdoor Recreation Plan, most recreationists do not distinguish the differences in management directives between local, county, state, and Federal lands and agencies (Graefe et al. 2009). For many visitors the refuge is considered another city park. Trail users at John Heinz NWR participate in activities typically not allowed on other wildlife refuges: dog walking, bicycling, and running. In recent years, we have received requests for increases in recreational use not considered to be wildlife-dependent including, but not limited to, geocaching and bike trail development. We are reevaluating compatible recreational uses as part of this comprehensive conservation planning process (see appendix B).

By improving signs to direct visitors, promoting compatible recreational use, and expanding recreational infrastructure, we will encourage wildlife-dependent recreational use and seek participation by up to 170,000 visitors annually. Under this plan, we will begin improvements in wildlife-dependent recreation by ensuring enforcement of inappropriate or non-compatible uses. We will upgrade and expand the onsite directional signs to better guide users, pedestrian traffic, and parking for cars and bicycles. In particular, we will work with the PENNDOT to develop self-serve contact stations at the trailheads located along State Highway 420. A contact station along this eastern entrance has been requested by Delaware County staff and neighboring residents for several years. The refuge receives numerous visitors throughout the year from this entrance

point. A contact station will welcome visitors and encourage interpretive uses at this location.

The majority of visitors at the refuge are interested in wildlife observation and experiencing nature. As we pursue an increase in visitation over the next 15 years, we hope to develop additional accessible infrastructure to expand opportunities for traditional wildlife observation, water-based wildlife observation and recreation, and trail access, primarily around Tinicum Marsh. Construction of additional observation platforms or blinds will be focused on improving observation of wildlife within Tinicum Marsh, improved trails and additional boardwalks will increase access to those observation areas. Access to Tinicum Marsh via waterways and water trails will be improved as well. We will expand access to Darby Creek and Tinicum Marsh by improving and adding canoe launches as well as exploring partnerships with neighboring marinas or boat launches to promote the refuge.

Strategies

Continue to:

- Provide visitors with the opportunity to engage in wildlife-dependent recreation opportunities throughout the year by:
 - ✱ Maintaining fishing piers and other bank access points along Darby Creek, including an Americans with Disabilities Act-compliant fishing pier.
 - ✱ Maintaining equipment loans (e.g., binoculars), photography blinds, viewing telescopes, hiking trails, water trails, and viewing platforms for wildlife observation and photography.
 - ✱ Providing brochures and other literature to support fishing and wildlife observation and photography on the refuge.
- Support hunting programs by facilitating PGC hunter education classes as well as distributing PGC hunting publications.
- Complete installation and networking of a Webcam viewing the bald eagle nest.
- Promote self-guided wildlife observation and photography by maintaining and providing equipment loans, photography blinds, boardwalks, and other structures outfitted with viewing telescopes.
- Have staff and volunteers guide programs including:
 - ✱ Regular bird and plant walks.
 - ✱ Sponsoring a photography contest and traveling photo exhibit.
 - ✱ Providing programs and camps designed specifically for families and youth, such as Through the Lens, and various summer camps.

Within 2 years of plan approval:

- Improve wildlife-viewing and photography by expanding enforcement of non-compatible trail uses.
- Explore opportunities to connect to regional bicycle trails and greenways to encourage non-motorized visits to the refuge.

Within 5 years of plan approval:

- Improve signs to direct pedestrian bicycle traffic and hiking accessibility as well as parking.
- Construct a self-serve contact station at State Road 420.

Within 15 years of plan approval:

- Construct a boardwalk into Tinicum Marsh to provide opportunities for visitor to observe wildlife and for us to better interpret the marsh.
- Based on the visitor service plan, construct additional fishing access points, bird and photography blinds, and non-motorized water recreation enhancements (i.e. canoe launches).
- Partner with neighboring marinas and boat launches to institute organized boat tours of Tinicum Marsh, upon request.

Monitoring Elements

- Annually complete an evaluation summary of wildlife-dependent recreation opportunities provided (number of opportunities, events, outreach efforts provided) and their utilization (number of visits, type of activity, and participants engaged).

Objective 5.2
Evaluate Possibility of
Providing Deer Hunting
Opportunities

In partnership with the PGC, evaluate the possibility of providing a quality deer hunt program by opening portions of refuge lands to public deer hunting.

Rationale

The PGC is interested in expanding hunting opportunities in Pennsylvania. In particular, there is interest in the refuge providing opportunities for a limited youth or handicap-accessible hunt, consistent with State and local regulations. At present, we have not developed a hunt program proposal to the extent that we could conduct a NEPA analysis and involve the public. Instead, within 10 years of CCP approval, we will initiate preliminary public scoping and detailed discussions with PGC about the possibility of opening the refuge to a limited deer hunt program. If there is public and PGC interest in pursuing a deer hunt program, we will identify and analyze a detailed proposal and involve the public before making a decision. Because the refuge provides important resting and foraging habitat for migrating birds as well as other species of conservation concern, there is limited marsh habitat available in the State, and because the available marsh habitat on the refuge is limited, we are not considering opening the refuge to migratory waterfowl hunting.

Hunting, if approved, will provide a priority public use in an area where public hunting opportunities have largely been eliminated by development. John Heinz NWR is in a unique position to offer limited deer hunting in an urban environment and there are potential benefits to refuge habitats associated with controlling the resident deer population. The Refuge Improvement Act specifically identifies hunting as a priority, wildlife-dependent recreational activity on refuges, and as such we are required to give it enhanced consideration on refuges. Our particular interest in evaluating a hunt program at this refuge stems from its urban location, limited upland areas, concentrated public use, potential concerns over public safety, and potential conflicts with one of the refuge's establishing purposes (i.e., providing opportunities for environmental education) and other priority public uses.

Strategies

Within 10 years of CCP implementation:

- Initiate preliminary public scoping and detailed conversations with the PGC to see if a detailed analysis of a deer hunt program is warranted.
- If warranted, partner with the PGC to evaluate in detail a proposal to provide opportunities for deer hunting on the refuge that are consistent with State and local regulations and laws. Other alternatives, including no action (i.e., no hunting) will be considered in this evaluation, and there will be additional opportunities for public involvement before a final decision will be made.

GOAL 6.

Communicate and collaborate with local communities, Federal and State agencies, Tribal governments, academic institutions, and conservation organizations throughout the Delaware Estuary to promote natural and cultural resource conservation and the mission of the National Wildlife Refuge System.

Objective 6.1 Role of Refuge in Regional Conservation

Within 15 years of CCP approval, establish the refuge as a regional center for hosting and sponsoring conservation-related events to facilitate collaboration with a variety of partners and increase community understanding and appreciation of the refuge's regional significance to natural resource conservation, its contribution to the Refuge System, and to garner additional support for refuge programs.

Rationale

The Philadelphia metropolitan area and the three states bordering the majority of the Delaware Estuary (Delaware, New Jersey, and Pennsylvania) contain numerous state and Federal agencies, dozens of nongovernmental conservation organizations, and hundreds of municipalities and environmentally concerned citizens. With this diversity of interested parties and stakeholders, the refuge plays a unique role in regional conservation efforts. The refuge's proximity to Philadelphia and Delaware County provides a facility for housing conservation workshops and meetings that bring together partners from around the region. The refuge is also the only Federal property within an hour drive of Philadelphia whose primary mission is wildlife conservation and management.

In addition to regular refuge volunteers, the Friends of the Heinz Refuge provides a great deal of support to the refuge in terms of volunteer assistance in carrying out all aspects of our mission. Their members participate and guide interpretive and educational programs, invasive species control workdays, monitoring efforts, and cleanup projects. Moving forward, we will continue to partner with Friends of Heinz Refuge and work together to accomplish our mission and management goals, while providing opportunities for volunteer participation.

The refuge's proximity to the city of Philadelphia, along with its location within the Delaware Estuary and close proximity to I-95 and other transportation routes (plane, bus, and rail), allows potential visitors multiple options for commuting to the refuge. The visitor center provides an easily accessible facility making it an ideal location for conservation-related meetings, workshops, and events. Under this plan, we will encourage the refuge's regional role in conservation as a center for meetings, workshops, and seminars. By housing these events, we introduce visitors to the refuge, foster regional efforts in habitat protection and environmental conservation, and introduce new audiences to the Refuge System.

In addition to providing facilities for conservation-related meetings by agencies and organizations from around the region, we will work to expand the refuge

and Service's role in regional conservation by hosting and/or leading technical workshops and meetings or by providing project tours, technical workshops, or public presentations. These efforts are focused on making us more visible to our partners and interested audiences around the region. By increasing our visibility in the conservation community of greater Philadelphia, we help promote the Service, Refuge System, and garner additional support for refuge programs.

Additionally, the refuge has a unique partnership with Philadelphia International Airport. The refuge has provided opportunities for previous wetland mitigation projects on the refuge. Both the airport and the refuge have also found common ground in their desire to preserve open space around the refuge and airport. The airport desires such lands for a safety, visual, and acoustic buffer, while some properties could also provide additional habitat buffers for refuge lands where applicable.

Strategies

Continue to:

- Collaborate with a diversity of partners (academic institutions, State and Federal agencies, transportation partners, municipalities, non-governmental organizations, private landowners, and businesses) on regional habitat issues and instilling the values of habitat conservation and environmental stewardship.
- Work with Philadelphia International Airport to conduct wetland mitigation, restoration, and land acquisition both on and off the refuge.
- Provide a facility for regional, conservation-related meetings, workshops, and activities, upon request.

Within 5 years of plan approval:

- Develop an interpretive exhibit outlining the refuge and the Refuge System's role and purpose in relation to other natural areas within the Delaware Estuary and the Landscape Conservation Cooperative.
- Annually host and lead at least two national or regional workshops related to climate change, biological management and monitoring, environmental education, or other topics supporting the refuge goals.

Within 15 years of plan approval:

- Work with academic institutions to encourage climate change research that will inform refuge management and will support regional and global initiatives on the effects of climate change.
- Study adjacent and nearby areas, including potential expansions to the refuge's acquisition boundary to determine ways the refuge can adapt to climate change.
- Explore opportunities to assess and evaluate ecosystem services provided by the refuge habitats through collaboration with universities and agencies.
- Establish and promote the refuge's role as a regional center for conservation, freshwater tidal marsh management, and fish and wildlife protection by providing project tours, technical workshops, or public presentations.

Monitoring Elements

- Annually complete an evaluation summary of partnership efforts and roles that the refuge has played in regional conservation through those partners/events.

Objective 6.2
Outreach and Partnerships

Throughout the life of the CCP, work with partners throughout the Philadelphia metropolitan area to increase community understanding and appreciation of the refuge's significance to natural resource conservation, its contribution to the Refuge System, and to garner additional support for refuge programs by increasing refuge visitation and participation in refuge programs.

Rationale

The vision for John Heinz NWR embodied in this CCP cannot be fulfilled without the continued and diverse benefits the refuge receives from its partnering organizations, businesses, and agencies. The refuge strives to generate partnerships with a broad array of local, regional, state, and national partners to achieve its conservation mission and mandated purpose. We accomplish this through a variety of events, sponsorships, and workshops provided by or with partner organizations. The work of the Friends of the Heinz Refuge is critical to this goal. The Friends and other volunteers provide support to refuge staff by operating the visitor center gift shop, organizing and participating in volunteer-led programs, and assisting in community outreach.

According to the Pennsylvania State Outdoor Recreation Plan (PADCNR 2009), many park users have a difficult time distinguishing the difference in land ownership, management focus, and mission between parks (municipal, State, national, and private) and national wildlife refuges. For John Heinz NWR, it is critical to communicate the refuge's role in wildlife conservation and habitat protection. We utilize a variety of local media outlets to convey this message and generate interest and visitation, including internet, radio, newsprint, and television media. Maintaining connections with these media outlets allows us to connect with diverse audiences that otherwise may not be reached.

Under this plan, we will continue these outreach avenues while pursuing increased partnership with area non-profit organizations, local tourist attractions, transportation agencies, and travel businesses. The refuge is located within a half-mile of the Philadelphia International Airport. With 18 hotels within a 4-mile radius of the refuge and airport, there is a large population of traveling public that is within close proximity to the refuge for an extended period of time. This presents an opportunity for the refuge to partner with area hotels and the Philadelphia Airport to highlight the refuge as a local point of interest.

In doing so, we will increase the refuge's visibility and generate increased interest by coupling with other local travel destinations such as Bartram's Gardens and Fort Mifflin. We anticipate that partnering with these and other local attractions can position the refuge and its neighbors as a local day-trip destination.

Strategies

Continue to:

- Maintain partnerships with at least ten organizations, agencies, and individuals in relation to the diverse habitats, programs, and goals encompassed by refuge management. Examples include:
 - ✱ 50 inner city volunteers through Student Conservation Association.
 - ✱ 600 volunteers from Big Brother/Big Sister for special event work days.
 - ✱ Nature Champions partnership.
- Maintain close partnership with Friends of the Heinz Refuge to support the refuge mission and management activities.
- Maintain weekly updates to refuge information station 1670 AM.

- Develop close partnerships with local print and broadcast media to reach diverse audiences through multiple channels.
- Conduct or sponsor at least three outreach programs or events each year and provide regular updates on refuge programming and events through local media outlets.

Within 2 years of plan approval:

- Pursue a specialized partnership with Fort Mifflin and Bartram's Gardens to co-schedule and promote events and programs.

Within 5 years of plan approval:

- Implement at least three examples of cross-referencing and publishing of workshops and events with partnering organizations.
- Work with at least three hotels around the airport to install a display advertising the refuge as a visitor destination to promote visitation.
- Provide refuge brochures to an additional 10 area hotels to promote refuge visitation.
- Work with PENNDOT, SEPTA, and Philadelphia International Airport to provide displays, brochures and information identifying the refuge as a visitor destination.
- Expand media outreach into online social networking and modern technology communications.

Within 10 years of plan approval:

- Work with PENNDOT, SEPTA, and Philadelphia International Airport to improve the visibility of and transportation connections to the refuge.

Monitoring Elements

- Annually complete an evaluation summary of partnership and outreach efforts and resulting benefits to the refuge (increased visitation, awareness, or understanding).

*Little
boardwalk*



Larry Woodward/USFWS

Chapter 5

Frank Miles/USFWS



Great blue heron feeding on common carp at the refuge

Consultation and Coordination

- 5.1 Introduction
- 5.2 Planning to Protect Land and Resources
- 5.3 Partners Involved in Refuge Planning
- 5.4 Contact Information

5.1 Introduction

This chapter describes how we engaged others in developing this CCP. In chronological order, it details our efforts to encourage the involvement of the public and conservation partners: other Federal and State agencies, Tribes, county officials, civic groups, nongovernmental conservation and education organizations, and user groups. It also identifies who contributed in writing the plan or significantly contributed to its contents.

It does not detail the dozens of informal discussions the refuge manager and his staff have had over the last two years where the CCP was a topic of conversation. Those involved a wide range of audiences, including local community leaders and other residents, refuge neighbors, refuge visitors, and other interested individuals. During those discussions, the refuge manager and his staff often would provide an update on our progress and encourage comments and other participation.

According to Service policy, we must review and update our final CCP at least once every 15 years. We may update the plan sooner, if we determine that we need to markedly change management direction or our Director or Regional Director deem it necessary. If so, we will once again announce our revised planning and encourage your participation.

5.2 Planning to Protect Land and Resources

January 2010

Our refuge planning began formally on January 21, 2010 during a conference call between refuge staff, regional office staff, and contractors. One of the major outcomes of the meeting was a timetable for accomplishing the major steps in the planning process and determining when and how we should involve others.

February 2010

Our pre-planning activities in February included development of a draft communications plan and finalizing the contact database for notification of the CCP and invitation to the agency scoping meeting. Invitations to the scoping meeting were sent to 55 Federal and State contacts, elected officials, and 13 federally recognized Tribes associated with Pennsylvania, Delaware, and New Jersey.

On February 3, 2010 refuge staff met with the contractor to identify data needs, obtain input on the contact database and review the CCP process.

On February 18, 2010 refuge staff, regional staff, and the contractor reviewed the agency scoping meeting agenda, meeting logistics, and determined the display maps and presentation materials needed for the meeting. We also discussed finalization of maps to show refuge boundaries, in-holdings, and utility right-of-ways.

On February 20, 2010 the refuge manager sent invitations to the agency scoping meeting with attachments that included: the meeting time and location, agenda, guidance on the refuge establishment authority, and the Service mission and Service policy that guides the CCP planning process.

March 2010

Our pre-planning and scoping activities in March included coordination with the Delaware Nation on participation in the CCP process; holding the agency scoping meeting on March 31, 2010; and preparing for and setting the date for the public scoping meeting for May 11, 2010.

On March 23, 2010 refuge staff, regional staff, and the contractor reviewed and commented on the agency scoping meeting presentation, meeting logistics, and display maps and handouts to be provided at the meeting.

On March 29, 2010 refuge staff, regional staff, and the contractor met at the visitor center to finalize the draft vision and goals, finalize meeting power point presentations, and set the date of May 11, 2010 for public scoping meetings during the afternoon and evening.

The agency scoping meeting was held on Wednesday, March 31, 2010 from 9:00 am to 2:00 pm at the visitor center and included a total of 26 attendees including the refuge staff and the core planning team. The list of attendees is attached and a summary of comments from the Federal agencies' representative is provided below. The meeting was an open house format with brief presentations on the CCP process and refuge status, and displays of the refuge context, habitat management units, visitor services and facilities, and handouts on the draft vision and goals.

April 2010

On April 20, 2010 refuge staff, regional staff, and the contractor reviewed and commented on the agency scoping meeting presentation, meeting logistics, and display maps and handouts to be provided at the public scoping meeting.

The press release announcing the scoping meeting and requesting public input was distributed to major media outlets on April 22, 2010.

A newsletter announcing the Service's intent to prepare a CCP and EA was prepared and distributed to 380 people on the contacts list. 280 of those contacts received the newsletter via email, while an additional 100 were mailed paper copies since no email address was available for those contacts. In addition, the refuge made an additional 200 copies available to the public in its visitor center.

May 2010

The Notice of Intent to prepare a CCP and EA for John Heinz NWR was published on May 7, 2010 (75 FR 25285), officially opening the public scoping period for comments through June 11, 2010.

We held two public scoping meetings which were at the refuge's visitor center on May 11, 2010 from 2:00 to 4:00 pm and from 6:30 to 8:30 pm.

The meetings included a total of 18 attendees, including refuge staff and the core planning team. The list of attendees is attached and a summary of comments from the attendees and those providing comments by June 11, 2010 is provided below. The meeting was an open house format with brief presentations on the CCP process and refuge status, and displays of the refuge context, habitat management units, visitor services and facilities, the past and planned marsh restoration projects, and handouts on the draft vision and goals.

June 2010

Our scoping activities in June included summarizing comments from the public scoping meeting and other written comments submitted before the official comment period ended on June 11, 2010.

On June 21, refuge staff, regional staff, and the contractor discussed the major issues identified in the public scoping meeting, decided on a format for summarizing the scoping comments, followed up with the education community, and discussed the content and deadlines for the newsletter. The core planning team also determined that the main objectives of meeting with the Service hydrologist would be to assist in evaluating hydrology issues, such as control of water in the impoundment, stormwater flowing onto the property from offsite sources, and monitoring needs for climate change and water management.

On June 29th the refuge staff, contractor, and Tinicum Township Engineer, Mr. Herb McCombie, met with the Service hydrologist from the Pennsylvania Ecological Service's Office, Dr. Larry Brannaka. They reviewed hydrology issues at the refuge, natural and man-made drainage south of the refuge that connects with or influences stormwater flowing onto the property, and flooding, tidal, and drainage issues in Tinicum Township. On June 30th the refuge staff, contractor, and Dr. Brannaka discussed the hydrology data needs for evaluating impoundment management options and monitoring needs for climate change and water management.

July 2010 through June 2011

The core team prepared a newsletter that informed interested parties of the summary of scoping activities and comments received during the public comment period. This newsletter was distributed on August 9, 2010 to approximately 294 contacts via email, plus an additional 88 paper copies were mailed to those contacts for which email addresses were unavailable.

From July through December 2010, the core team worked together to analyze comments and evaluate alternative management options that would help achieve the refuge's purposes and draft goals. Over the course of three workshop-style meetings, the core team developed the basic framework for what is proposed within this draft CCP/EA.

From December 2010 through June 2011, the planning team developed alternatives, completed appendices, and wrote and edited the various chapters.

March 2012	On March 22, 2012, we announced the availability of the draft CCP/EA in the <i>Federal Register</i> for 30 days of public review and comment. We also distributed a newsletter, sent out a press release announcing the public comment period. The Federal Register notice, newsletter, press release, and our planning Web site also announced the two public meetings we planned for April 2012.
April 2012	We hosted two public meetings at the refuge. At each of the meetings we gave a short overview of the refuge and the CCP planning process. We also recorded all the comments and suggestions provided at the meetings.
May 2012	We compiled and considered all the public comments we received and drafted a response to each substantive comment. Based on these substantive comments, we reviewed and revised, where appropriate, the draft CCP/EA.
June to July 2012	We compiled the final CCP for the Regional Supervisor, Regional Chief, and Regional Solicitor's Office before submitting it to the Regional Director for review and approval. The Regional Director determined a Finding of No Significant Impact was appropriate, and approved the final CCP. We published another <i>Federal Register</i> Notice of Availability to announce the availability of the final plan.
Congressional Meetings	
May 21, 2009	Met with Congressional Staff Eriade Hunter (Congressman Robert Brady, PA-1), Kasey Gillette (Senator Robert Casey, Jr.), and Alex Halper (Senator Arlen Specter) with Sue McMahon from FWS-Region 5.
December 8, 2010	Met with Congressional Staff-Maureen O'Dea (Senator Robert Casey, Jr.) and Ashley Shillingsburg (Congressman Robert Brady, PA-1) with Joseph McCauley from FWS-Region 5.

5.3 Partners Involved in Refuge Planning

Refuge programs enjoy a great deal of support from outside the Service in many areas, including: conducting biological surveys, enhancing public use and refuge programs, restoring habitat, and protecting land. Our partnerships will continue to expand under the increasing interest in conserving refuge resources. Since January 2010, we have contacted the following partners to apprise them of the planning process and encourage their involvement.

- Academy of Natural Sciences
- American Birding Association
- American Fisheries Society
- American Sportsfishing Association
- AmeriCorps Vista
- Army Corp of Engineers, Regulatory Branch
- Assateague Coastal Trust
- Audubon Society, Valley Forge Chapter
- Audubon, Mill Grove
- Bartram's Garden
- Borough of Folcroft
- Borough of Norwood
- Borough of Prospect Park
- Boy Scouts of America, Cradle of Liberty Council

- Brandywine Conservancy, Inc.
- Brandywine Environmental Education Center
- Brandywine Valley Association, Inc.
- Brandywine Visitor Bureau
- Brandywine Zoo
- Brandywine CVB
- Cabrini College
- Camden Academy
- Cayuga Nation
- Chester Valley Sportsmen Association
- Chester-Ridley-Crum Watershed Association
- Chestnut Hill Local
- Clean Air Council
- Clean Water Action
- Congressional Sportsmen's Foundation
- Congressman Joe Sestak
- Congressman Robert Brady
- Cooperative Alliance for Refuge Enhancement
- Council on Environmental Quality
- Daily Pennsylvanian
- Darby Borough
- Darby Creek Valley Association
- Darby Township
- Darby-Cobbs Watershed Partnership
- Pennsylvania Department of Conservation and Natural Resources
- Defenders of Wildlife
- Delaware Coastal Management Program
- Delaware County Conservation District
- Delaware County Cooperative Extension of Penn State
- Delaware County Field and Stream Association
- Delaware County Institute of Science
- Delaware County Orienteering Association
- Delaware County Parks and Recreation Board
- Delaware County Planning Department
- Delaware County Solid Waste Authority
- Delaware Estuary Program
- Delaware Museum of Natural History
- Delaware Nation of Oklahoma
- Delaware Nature Society
- Delaware Planning Department
- Delaware River and Bay Authority
- Delaware River Basin Commission
- Delaware Riverkeeper Network
- Delaware Tribe
- Delaware Valley Regional Planning Commission
- Drexel University
- Ducks Unlimited, Inc.
- EarthForce
- Eastern Lenape Nation of Pennsylvania
- EHY Associates

- Energy Coordinating Agency of Pennsylvania
- Environmental Defense Fund
- Federal Aviation Administration
- Fairmount Park Commission
- French Creek State Park
- Friends of Heinz Wildlife Refuge
- Forest Partners International
- Fort Mifflin
- Franklin Institute
- Girl Scouts of Eastern Pennsylvania
- GreenSpace Alliance
- Haverford College
- Hawk Mountain Sanctuary
- International Association of Fish and Wildlife Agencies
- Keystone Trails Association
- Longwood Gardens
- Mid-Atlantic Council of Watershed Associations
- Morris Arboretum
- Nanticoke Indian Association, Inc.
- Nanticoke Lenni-Lenape
- National Audubon Society
- National Fish and Wildlife Foundation
- National Oceanic and Atmospheric Association
- National Rifle Association of America
- National Trappers Association, Inc.
- National Wildlife Federation
- National Wildlife Refuge Association
- Natural Lands Trust, Inc.
- Natural Resources and Conservation Service
- New Jersey Adventure Aquarium
- New Jersey Department of Environmental Protection
- National Oceanic and Atmospheric Administration
- North American Butterfly Association
- National Water Resources Association
- Oneida Indian Nation
- Onondaga Nation
- Pennsylvania Association of Conservation Districts
- Pennsylvania Bureau of Forestry–William Penn District
- Pennsylvania Citizens Advisory Council
- Pennsylvania Department of Environmental Protection
- Pennsylvania Fish and Boat Commission
- Pennsylvania Forestry Association
- Pennsylvania Game Commission
- Pennsylvania Senate and House of Representatives
- Pennsylvania State Museum
- Partnership for the Delaware Estuary
- Patrick Center for Environmental Research
- Pennsylvania Department of Transportation

- Pennsylvania Environmental Council
- Pennsylvania Federation of Sportsmen Clubs
- Pennsylvania Recreation and Park Society, Inc.
- Pennsylvania Resource Council
- Pennsylvania Sea Grant
- Pennsylvania State Preservation, Historical Museum Commission
- Philadelphia Recreation Department
- Philadelphia Herpetological Society
- Philadelphia University – School of Science and Health
- Philadelphia Water Department
- Philadelphia Zoo
- Rails to Trails
- REED
- Ridley Creek State Park
- Ridley Township
- Ridley Township Business Association
- Rutgers Cooperative Extension of Camden County
- Rutgers University, Haskin Shellfish Research Laboratory
- Safari Club International
- Student Conservation Association
- Schuylkill Center for Environmental Education
- Senator Arlen Specter
- Senator Robert P. Casey, Jr.
- Seneca Nation Tribal Historic Preservation
- Senior Environmental Corp
- Southeastern Pennsylvania Transportation Authority
- Sierra Club – Eastern Pennsylvania Group
- Stroud Water Resources Center
- Swarthmore College
- Temple University
- The Academy of Natural Sciences
- The Conservation Fund
- The Corps Network
- The Humane Society of the United States
- The Izaak Walton League of America, Inc.
- The Nature Conservancy
- The Wilderness Society
- The Wildlife Legislative Fund of America
- The Wildlife Society
- Tinicum Township
- Tri-State Bird Rescue & Research
- Trout Unlimited
- Trust for Public Land
- Tyler Arboretum
- US Department of Transportation
- US Environmental Protection Agency
- Union of Concerned Scientists
- United American Indians of Delaware Valley, Inc.
- University of Delaware

- University of Sciences, Philadelphia
- Ursinus College
- US Geological Survey
- US Department of Agriculture
- Villanova University
- Wagner Free Institute of Science
- Webbed Foot Wildlife Rehab
- Western Pennsylvania Conservancy–
Natural Heritage Division
- Widener University
- Wildlife Forever
- Wildlife Management Institute
- Wildlife Rehabilitation Clinic
- William Rush Memorial Bird
Carvers Association

5.4 Contact Information

Gary M. Stolz, Refuge Manager

U.S. Fish and Wildlife Service
 John Heinz National Wildlife Refuge at Tinicum
 8601 Lindbergh Boulevard
 Philadelphia, PA 19153
 Phone: 215-365-3118
 Fax: 215-365-2846
<http://www.fws.gov/heinz/index.html>

Lia McLaughlin

Natural Resources Planner, Northeast Region
 U.S. Fish and Wildlife Service
 300 Westgate Center Drive
 Hadley, MA 01035-9587
 Phone: 413-253-8575
 Fax: 413-253-8468
<http://northeast.fws.gov/planning>

Chapter 6

Ron Holmes/USFWS



Osprey soaring over waters at the refuge

List of Preparers

- 6.1 Members of the Core Planning Team
- 6.2 Assistance from Other Service Personnel

6.1 Members of the Core Planning Team

Service Personnel	Gary Stolz	<i>Refuge Manager</i> , John Heinz National Wildlife Refuge at Tinicum
	Larry Woodward	<i>(former) Deputy Refuge Manager</i> , John Heinz National Wildlife Refuge at Tinicum
	Brendalee Phillips	<i>Refuge Biologist</i> , John Heinz National Wildlife Refuge at Tinicum
	Lia McLaughlin	<i>Natural Resource Planner</i> , Northeast Region, Region 5 Regional Office
State Agency Personnel	Eric Miller	<i>Chief</i> , Public Lands Habitat Section–Bureau of Wildlife Habitat Management, Pennsylvania Game Commission
Contractor Personnel	Dan Salas	<i>Ecologist</i> , ESA Certified, Cardno JFNew
	Dave Williams	<i>Project Manager</i> , Land & Stream Improvements LLC
6.2 Assistance from Other Service Personnel	Mariana Bergerson	<i>Deputy Refuge Manager</i> , John Heinz National Wildlife Refuge at Tinicum
	Dr. Larry Brannaka	<i>Hydrologist</i> , Pennsylvania Ecological Services Office
	William Buchanan	<i>Outdoor Recreation Planner</i> , John Heinz National Wildlife Refuge at Tinicum
	Laurel Carpenter	<i>Assistant Outreach Coordinator</i> , Northeast Region, Region 5 Regional Office
	Margaret Engesser	<i>Assistant Outreach Coordinator</i> , Northeast Region, Region 5 Regional Office
	Katie Fox	<i>Assistant Outreach Coordinator</i> , Northeast Region, Region 5 Regional Office
	Thomas Hughes	<i>Maintenance Worker</i> , John Heinz National Wildlife Refuge at Tinicum
	Suzanne Kelley	<i>Supervisory Park Ranger</i> , John Heinz National Wildlife Refuge at Tinicum
	Nancy McGarigal	<i>Refuge Planner</i> , Northeast Region, Region 5 Regional Office
	Michael McMenamin	<i>Facility Manager</i> , John Heinz National Wildlife Refuge at Tinicum
	Derik Pinsonneault	<i>Park Ranger (Law Enforcement)</i> , John Heinz National Wildlife Refuge at Tinicum
	Erika Scarborough	<i>Outdoor Recreation Planner</i> , John Heinz National Wildlife Refuge at Tinicum

Laura Shaffer	<i>(former) Assistant Outreach Coordinator, Northeast Region, Region 5 Regional Office</i>
Kate Toniolo	<i>Regional Visitor Services and Communications Coordinator, Northeast Region, Region 5 Regional Office</i>
Cynthia White	<i>(former) Assistant Outreach Coordinator, Northeast Region, Region 5 Regional Office</i>
John Wilson	<i>Regional Historic Preservation Officer, Northeast Region, Region 5 Regional Office</i>

Bibliography



USFWS

Green frog

Bibliography

Bibliography

- Albert, R.C. June 1988. The historical context of water quality management for the Delaware Estuary. *Estuaries* 11(2). Estuarine Research Federation.
- Allombert, S., A.J. Gaston, and J. Martin. June 2005. A natural experiment on the impact of overabundant deer on songbird populations. *Biological Conservation* 126:1-13.
- American Bird Conservancy (ABC). 2009. Cats indoor! The campaign for safer birds and cats. Accessed September 17, 2010. [Online version available at <<http://www.abcbirds.org/abcprograms/policy/cats/index.html>>]
- American Ornithologists' Union (AOU). 1983. Check-list of North American birds, sixth edition. Allen Press, Inc., Lawrence, Kansas. 877 pp.
- . 1998. Check-list of North American birds, seventh edition. American Ornithologists' Union, Washington, DC. 829 pp.
- Andrew, J.M. and J.A. Mosher. 1982. Bald eagle nest site selection and nesting habitat in Maryland. *Journal of Wildlife Management* 46:382-390.
- Aniskowicz, B.T. 1981. Behavior of a male least bittern *Ixobrychus exilis* after loss of mate. *Wilson Bulletin* 93:395-397.
- Anthony, R.G. and F.B. Isaacs. 1989. Characteristics of bald eagle nest sites in Oregon. *Journal of Wildlife Management* 53:148-159.
- Anthony, R.G., M.G. Garrett, and C.A. Schuler. 1993. Environmental contaminants in bald eagles in the Columbia River Estuary. *Journal of Wildlife Management* 57(1):10-19.
- Arrese, P. 1987. Age, intrusion pressure and defense against floaters by territorial male song sparrows. *Animal Behavior* 35:773-784
- Aquabiologists, Inc. 2011. Clearcast. Accessed February 2, 2011. [Online version available at <www.aquaticbiologists.com/clearcasr.htm>] MSDS from BASF, revision date 2008/02/29.
- Audubon, J.J. 1843. *Birds of America*. Vol. 6. J.B. Chevalier, Philadelphia, Pa.; J.J. Audubon, New York.
- Banks, P.B. and J.V. Bryant. 2007. Four legged friend or foe? Dog walking displaces native birds from natural areas. *Biology Letters* 3:611-613.
- Barnes, J.H. and W.D. Sevon. 2002. *The Geological Story of Pennsylvania*, third edition. Pennsylvania Geological Survey, Educational Series 4. 44 pp.
- Baumann, P.C. 2002. Beneficial use impairment #4: Fish tumors and other deformities. In: Workshop on Delisting Criteria on the Detroit River Area of Concern. Proceedings of a workshop held at the University of Windsor, April 26-27, 2002. Environment Canada, Burlington, Ontario. 124 pp.
- Bell, B. 2005. The Effects of crude oil contamination on the reproduction of freshwater turtles. Drexel University Doctoral Thesis. 129 pp.
- Bent, A.C. 1938. Life histories of North American birds of prey. Part 2. U.S. Natural Museum Bulletin 170. 482 pp., 92 pls.
- Bennett, K. and E. Zuelke. 1999. The effects of recreation on birds: a literature review. Unpublished report. Submitted to: DE Division of Parks and Recreation, DNREC.

- Bertin, R.I. 1977. Breeding habitats of the wood thrush and veery. *The Condor* 79:303-11.
- Bogert, C.M. 1960. The influence of sound on the behavior of amphibians and reptiles. In: *Animal Sounds and Communications* (Lanyon, W.E. and W.N. Tavolga, eds), pp. 137-320. American Institute of Biological Science, Washington, DC.
- Botton, M.L., R.E. Loveland, and T.R. Jacobsen. 1994. Site selection by migratory shorebirds in Delaware Bay, and its relationship to beach characteristics and abundance of horseshoe crab (*Limulus polyphemus*) eggs. *Auk* 111:605-616.
- Bove, J. 2010. The refuge is the best fishing spot in Philadelphia, Pennsylvania. Yahoo Associated Content.
- Bozeman, E.L., Jr. and M.J. Van Den Avyle. 1989. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (South Atlantic)—alewife and blueback herring. USFWS. Biol. Rep. 82(11.111). 17 pp.
- Brattstrom, B.H. and M.C. Bondello. 1983. Effects of off-road vehicle noise on desert vertebrates. In: *Environmental Effects of Off-road Vehicles: Impacts and Management in Arid Regions* (R.H. Webb and H.G. Wilshire, eds.), pp.167-206. Springer-Verlag, NY.
- Bridgham, S.D., J.P. Megonigal, J.K. Keller, N.B. Bliss, and C. Trenttin. 2006. The carbon balance of North American wetlands. *Wetlands* 26(4):889-916. [Online version available at <http://ceeb.uoregon.edu/Bridgham/pubpdfs/art_56.pdf>]
- Brown, M. and J.J. Dinsmore. 1986. Implications of marsh size and isolation for marsh bird management. *Journal of Wildlife Management* 50:392-397.
- Buehler, D.A., T.J. Mersmann, J.D. Fraser, and J.K.D. Seeger. 1991. Effects of human activity on bald eagle distribution on the northern Chesapeake Bay. *Journal of Wildlife Management* 55:282-290.
- Burger, J. 1981. Effect of human activity on birds at a coastal bay. *Biological Conservation* 21:231-241.
- . 1986. The effect of human activity on shorebirds in two coastal bays in northeastern United States. *Biological Conservation* 13:123-130.
- Burger, J. and M. Gochfield. 1981. Discrimination of the threat of direct versus tangential approach to the nest by incubating herring and great black-backed gulls. *Journal of Comparative Physiological Psychology* 95:676-684.
- . 1998. Effects of ecotourists on bird behaviour at Loxahatchee National Wildlife Refuge, Florida. *Environmental Conservation* 25:13-21.
- Burger, J., M. Gochfeld, and L.J. Niles. 1995. Ecotourism and birds in coastal New Jersey: Contrasting responses of birds, tourists, and managers. *Environmental Conservation* 22:56-65.
- Bushman, E.S. and G.D. Therres. 1988. Habitat management guidelines for forest interior breeding birds of coastal Maryland. Maryland Department of Natural Resources, Wildlife Technical Publication 88-1. 50 pp.

- Buyanovsky, G.A. and G.H. Wagner. 1998. Carbon cycling in cultivated land and its global significance. *Global Change Biology* 4:131-141. [Online version available at <<http://onlinelibrary.wiley.com/doi/10.1046/j.1365-2486.1998.00130.x/pdf>>]
- California Department of Fish and Game (CDFG). 2009. Cats and wildlife. Retrieved September 17, 2010. [Online version available at <http://www.dfg.ca.gov/wildlife/nongame/nwis_exo/dom_cat/index.html>]
- Campbell, R.W., N.K. Dawe, I. McTaggart-Cowan, J.M. Cooper, G.W. Kaiser, and M.C. McNall. 1990. The Birds of British Columbia. Volume 2. Nonpasserines: Diurnal Birds of Prey through Woodpeckers. University of British Columbia Press, Vancouver, B.C. 636 pp.
- Carter, V. 1996. Technical aspects of wetlands, wetland hydrology, water quality, and associated functions. In: National Water Summary on Wetland Resources (J.D. Fretwell, J.S. Williams, and J.R. Redman, compilers), pp. 35-48. United States Geological Survey, Water-Supply Paper 2425. 431 pp. [Online version available at <<http://www.google.com/books?id=UDU411JLwI8C>>]
- Carver, E. and J. Caudell. 2007. Banking on nature 2006: the economic benefit to local communities of national wildlife refuge visitation. U.S. Fish and Wildlife Service Division on Economics, Washington, DC.
- Castro, G. and J.P. Myers. 1993. Shorebird predation on eggs of horseshoe crabs during spring stopover on Delaware Bay. *Auk* 110:927-930.
- Chen, J.L., C.R. Wilson, and B.D. Tapley. 2006. Satellite gravity measurements confirm accelerated melting of the Greenland ice sheet. *Science* 313:1958.
- Christman, S.P. 1984. Breeding bird response to greentree reservoir management. *Journal of Wildlife Management* 48:1164-1172.
- Clark, K.E., L.J. Niles, and the North Atlantic Shorebird Habitat Working Group. 2000. U.S. Shorebird Conservation Plan: North Atlantic Regional Shorebird Plan Version 1.0. <http://www.fws.gov/shorebirdplan/RegionalShorebird/downloads/NATLAN4.pdf>; accessed January 2012.
- Clark, R.J. 1975. A field study of the short-eared owl (*Asio flammeus*) Pontopidan in North America. *Wildlife Monographs* 47:1-67.
- Clean Air Council. Transportation. Anit-idling, diesel campaign, freight transport, bike/pedestrian trails, and sustainable commute. [Online version available at <<http://www.cleanair.org/program/transportation>>]
- Clough J., R.A. Park, and R. Fuller. 2010. SLAMM 6 Beta Technical Documentation: Release 6.0.1 Beta. Warren Pinnacle Consulting, Inc., Warren, Vermont. [Online version available at <http://warrenpinnacle.com/prof/SLAMM6/SLAMM6_Technical_Documentation.pdf>]
- Cohen, M. and J. Johnson. 2004. Pennsylvania Important Bird Area #73: John Heinz National Wildlife Refuge at Tinicum Phase 1 Report May 2004. Audubon Society.
- Combs, K.P. and S.M. Melvin. 1989. Population dynamics, habitat use and management of short-eared owls on Nantucket Island, Massachusetts. Massachusetts Division of Fish and Wildlife, Natural Heritage and Endangered Species Program, Boston, Massachusetts. Unpublished progress report. 24 pp.

- Craft, C., J. Clough, J. Ehman, S. Joye, R. Park, S. Pennings, H. Guo, and M. Machmuller. 2008. Effects of accelerated sea level rise on delivery of ecosystem services provided by tidal marshes: a simulation of the Georgia (USA) coast. *Frontiers in Ecology and the Environment* 7:73–78.
- D'Angelo, G.J. 2009. Personal Communication.
- D'Angelo, G.J. 2012. Final white-tailed deer management plan for John Heinz National Wildlife Refuge at Tinicum, Philadelphia, Pennsylvania. August 2012. USDA-APHIS. 76 pp.
- Dadswell, M.J., B.D. Taubert, T.S. Squiers, D. Marchette, and J. Buckley. 1984. Synopsis of biological data on shortnose sturgeon, *Acipenser brevirostrum* LeSueur 1818. National Oceanic and Atmospheric Administration Technical Report NMFS 14, Washington D.C.
- Darby Creek Valley Association (DCVA). November 2005. Darby Creek Watershed Comprehensive Plan. [Online version available at <<http://www.dcva.org>>]
- deCalesta, D.S. 1994. Impact of white-tailed deer on songbirds within managed forests in Pennsylvania. *Journal of Wildlife Management* 58:711-718.
- DeGraaf, R.M., G.M. Whitman, J.W. Lanier, B.J. Hill, and J.M. Keriston. 1980. Forest habitat for birds of the Northeast. United States Forest Service, Northeast Forest Experiment Station, 598 pp.
- DeGraaf, R.M. and D.D. Rudis. 1983. Amphibians and reptiles of New England. Habitats and natural history. University of Massachusetts Press. vii + 83 pp.
- Delaware Estuary Program (DEP). 1996. Comprehensive conservation and management plan for the Delaware Estuary. Wilmington, Delaware. 470 pp.
- Delaware River Basin Commission (DRBC). 2004. 2004 Delaware river and bay surface water quality assessment report for 2000–2002.
- Delaware Valley Regional Planning Commission (DVRPC). 2009. Traffic counts for I-95 in the Philadelphia area. [Online version available at <<http://www.dvrpc.org>>]
- del Hoyo, J. A. Elliot, and J. Sargatal. 1996. Handbook of the birds of the world. Volume 3. Lynx Editions. Barcelona. 821 pp.
- DeMauro, M.M. 1993. Colonial nesting bird responses to visitor use at Lake Renwick heron rookery, Illinois. *Natural Areas Journal* 13:4-9.
- Dow Agrosiences. 2009. Garlon 4 MSDS, Revision Date 2009/03/09, [Online version available at <<http://www.cdms.net/ldat/mp0B0014.pdf>>]
- Dubec, L.J., W.B. Krohn, and R.B. Owen, Jr. 1990. Predicting occurrence of river otters by habitat on Mount Desert Island, Maine. *Journal of Wildlife Management* 54:594-599.
- Elliot, K., J. Duffe, S.L. Lee, P. Mineau, and J.E. Elliot. 2006. Foraging ecology of bald eagles at an urban landfill. *The Wilson Journal of Ornithology* 118(3):380-390.

- Elliot, L. 1978. Social biology and foraging ecology of the eastern chipmunk (*Tamias striatus*) in the Adirondack Mountains. *Smithsonian Contributions to Zoology* 265:1-107.
- Entrix, Inc. 2005. Final report: sunoco pipeline release incident at John Heinz National Wildlife Refuge, Philadelphia, PA. Prepared for Sunoco, Inc. (R&M) and Sun Pipeline Company, Philadelphia, PA. June 3, 2005. Project No.: 7089309.
- Ernst, C.H. and R.W. Barbour. 1972. *Turtles of the United States*. University Press of Kentucky, Lexington, KY. 347 pp.
- Escobedo, F., R. Northrop, and W. Zipperer. 2007. Developing an urban forest management plan for hurricane-prone communities. University of Florida. [Online version available at <<http://edis.ifas.ufl.edu/pdf/files/FR/FR17600.pdf>>]
- Ewald P.W. and F.L. Carpenter. 1978. Territorial responses to energy manipulations in the Anna hummingbird. *Oecologia* 31:277-292.
- Fay, C.W., R.J. Neves, and G.B. Pardue. 1983. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (mid-Atlantic): alewife/blueback herring. FWS/OBS-82/11.9.
- Federal Aviation Administration (FAA). 2005. Final Record of Decision for the Philadelphia International Airport's Runway 17-35 Expansion Project. April 29, 2005. 49 pp.
- Ferris, C.R. 1979. Effects of interstate 95 on breeding birds in northern Maine. *Journal of Wildlife Management* 43:421-427.
- Feunteun, E., P. Laffaille, T. Robinet, C. Briand, A. Baisez, J.M. Olivier, and A. Acou. 2003. A review of upstream migration and movements in inland waters by anguillid eels: toward a general theory. In: *Eel Biology* (K. Aida, K. Tsukamoto, and K. Yamauchi, eds.), pp. 191-123. Springer, Tokyo.
- Flowerdew, J.R. and S.A. Elwood. 2001. Impact of woodland deer on small mammal ecology. *Forestry* 74:277-287.
- Frank, K.D. 1988. Impact of outdoor lighting on moths: an assessment. *Journal of the Lepidopterists' Society* 42(2):63-93.
- . 2002. Impact of artificial lighting on moths. In: *Abstracts of Ecological Consequences of Artificial Night Lighting*. Los Angeles, CA. [Online version available at <<http://www.urbanwildlands.org/abstracts.html>>]
- Frazer, C., J.R. Longcore, and D.G. McAuley. 1990a. Habitat use by postfledging American black ducks in Maine and New Brunswick. *Journal of Wildlife Management* 54:451-459.
- . 1990b. Home range and movements of postfledging American black ducks in eastern Maine. *Canadian Journal of Zoology* 68:1288-1291.
- Gladwin, D.N., D.A. Asherin, and K.M. Mancini. 1987. Effects of aircraft noise and sonic booms on fish and wildlife: results of a survey of U.S. Fish and Wildlife Service Endangered Species and Ecological Services Field Offices, Hatcheries, and Research Centers. NERC-88/30. U.S. Fish and Wildlife Service, National Ecology Research Center, Fort Collins, CO. 24 pp.

- George, S. and K. Crooks. 2006. Recreation and large mammal activity in an urban nature reserve. *Biological Conservation* 133:107-117.
- Gerrard, J.M., P.N. Gerrard, G.R. Bortolotti, and E.H. Dzus. 1992. A 24-year study of bald eagles on Besnard Lake, Saskatchewan. *Journal of Raptor Research* 26:159-166.
- Gibbs, J.P. and S.M. Melvin. 1990. An assessment of wading birds and other wetlands avifauna and their habitats in Maine. Maine Department of Inland Fish. and Wildlife, Bangor, ME. 61 pp. Unpublished report.
- . 1992. American bittern, *Botaurus lentiginosus*. In: *Migratory nongame birds of management concern in the Northeast* (K. J. Schneider and D. M. Pence, eds.), pp. 51-69. U.S. Fish and Wildlife Service, Newton Corner, MA. 400 pp.
- Gill, J.A., W.J. Sutherland, and A.R. Watkinson. 1996. A method to quantify the effects of human disturbance on animal populations. *Journal of Applied Ecology* 33:786-792.
- Goodrich, L., M. Brittingham, J. Bishop, and P. Barber. 2001. Wildlife habitat in Pennsylvania: past, present, and future. Pennsylvania Department of Conservation and Natural Resources. Harrisburg, PA. [Online version available at <<http://www.dcnr.state.pa.us/wlhabitat/commonwealth.aspx>>]
- Graefe, A., A. Mowen, E. Covelli, and N. Trautwein. 2011. Recreation participation and conservation attitudes: differences between mail and online respondents in a mixed-mode survey. *Human Dimensions of Wildlife* 16:183-199.
- Greater Philadelphia Tourism Marketing Corporation (GPTMC). 2009. Tourism 2009: Report to the region: the big picture. [Online version available at <<http://www.visitphilly.com/research/annual-report/>>]
- Green A.W., W.L. Kendall, H.P. Laskowski, J.E. Lyons, L. Socheata, and M.C. Runge. 2008. Draft version of the USFWS R3/R5 Regional Impoundment Study November 2008. U. S. Fish and Wildlife Service.
- Green, N. 1985. The Bald Eagle. In: *Audubon Wildlife Report 1985* (R.L. DiSilvestro, ed.), pp. 508-531. National Audubon Society, New York.
- Griffin, D.R. and C.D. Hopkins. 1974. Sounds audible to migrating birds. *Animal Behavior* 22:672-678.
- Grubb, T.G. and R.M. King 1991. Assessing human disturbance of breeding bald eagles with classification tree models. *Journal of Wildlife Management* 55:500-511.
- Gutzwiller, K.J., R.T. Wiedenmann, K.L. Clements, and S.H. Anderson. 1994. Effects of human intrusion on song occurrence and singing consistency in subalpine birds. *The Auk* 111:28-37.
- Hammit, W.E. and D.N. Cole. 1998. *Wildland recreation: ecology and management* (2nd edition). New York: John Wiley and Sons. 361 pp.
- Hammerson, G. and D.W. Mehlman. 1995. American bittern species profile. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. Accessed on February 2, 2011. [Online version available at <<http://www.natureserve.org/explorer>>]

- Haro, A.J. and W.H. Krueger. 1991. Pigmentation, otolith rings, and upstream migration of juvenile American eels (*Anguilla rostrata*) in a coastal Rhode Island stream. *Canadian Journal of Zoology* 69:812-814.
- Harrison, C. 1978. *A Field Guide to the Nests, Eggs and Nestlings of North American Birds*. Collins, Cleveland, Ohio.
- Hassler, T.J. 1988. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (Pacific Southwest)—striped bass. USFWS Biology Report 83(11.82). U.S. Army Corps of Engineers, TR EL-82-4. 29 pp.
- Hastings, R.W., J.C. O'Herron, II, K. Schick, and M.A. Lazzari. 1987. Occurrence and distribution of shortnose sturgeon, *Acipenser brevirostrum*, in the upper tidal Delaware River. *Estuaries* 10:337-341.
- Hayhoe, K., C.P. Wake, T.G. Huntington, L. Luo, M.D. Schwartz, J. Sheffield, E. Wood, B. Anderson, J. Bradbury, A. DeGaetano, T.J. Troy, and D. Wolfe. 2007. Past and future changes in climate and hydrological indicators in the U.S. Northeast. *Climate Dynamics*, 28(4):381-407.
- Heath, L.S. and J.E. Smith. 2004. Criterion 5, indicator 27: Contribution of forest ecosystems to the total global carbon budget, including absorption and release of carbon (standing biomass, coarse woody debris, peat and soil carbon). In: *A Supplement to the National Report on Sustainable Forests 2003 FS-766A* (Darr, D.R., ed.) pp.1-7. U.S. Department of Agriculture, Washington, DC. [Online version available at <http://www.fs.fed.us/ne/durham/4104/papers/Heath_Smith_Indicator27_2004.pdf>]
- Herpetological Associates. 2001a. Endangered and threatened wildlife species surveys in wetlands throughout Philadelphia International Airport, Delaware and Philadelphia Counties, Pennsylvania October 2001.
- . 2001b. Master plan technical report no. 2: a survey of fishes of the Philadelphia International Airport and the adjacent Delaware River Estuary.
- Holt, D.W. and S.M. Melvin. 1986. Population dynamics, habitat use, and management needs of the short-eared owl in Massachusetts: summary of 1985 research. Massachusetts Division of Fish and Wildlife, Natural Heritage Program, Boston, MA.
- Inkley, D.B., M.G. Anderson, A.R. Blaustein, V.R. Burkett, B. Felzer, B. Griffith, J. Price, and T.L. Root. 2004. Global climate change and wildlife in North America. *Wildlife Society Technical Review* 04-2. The Wildlife Society, Bethesda, MD. 26 pp.
- Intergovernmental Panel on Climate Change (IPCC). 2007. Summary for Policymakers of the Synthesis Report of the IPCC Fourth Assessment Report. Valencia, Spain. [Online version available at <http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf>]
- Iverson, L., A. Prasad, and S. Matthews. 2008: Potential changes in suitable habitat for 134 tree species in the northeastern United States. *Mitigation and Adaptation Strategies for Global Change* 13(5-6):487-516.
- Kim, J.C., and N. Teamerson. 2011. Final phase i archaeological survey report: Lower Darby Creek area site, Delaware and Philadelphia Counties, Pennsylvania. Work Assignment No. 023-RICO-D366. Remedial Action Contract (RAC) Number EP-S3-07 -04. 101 pp.

- Klein, M.L. 1993. Waterbird behavioral responses to human disturbance. *Wildlife Society Bulletin* 21:31-39.
- Klein, M.L., S.R. Humphrey, and H.F. Percival. 1995. Effects of ecotourism on distribution of waterbirds in a wildlife refuge. *Conservation Biology*:1454-1465.
- Knight, R.L. 1984. Responses of wintering bald eagles to boating activity. *Journal of Wildlife Management* 48(3):999-1004.
- Knight, R.L. and D.N. Cole. 1991. Effects of recreational activity on wildlife in wildlands. *Transactions of the 56th North American Wildlife and Natural Resources Conference* pp. 238-247.
- Krause, B. 1999. Loss of Natural Soundscapes Within the Americas. Paper presented at the FICAN Symposium on Preservation of Natural Quiet Acoustical Society of America Session 3aNS, November 3, 1999.
- Kreeger, D., J. Adkins, P. Cole, R. Najjar, D. Velinsky, P. Conolly, and J. Kraeuter. 2010. Climate change and the Delaware Estuary: three case studies in vulnerability assessment and adaptation planning. Partnership for the Delaware Estuary, PDE Report No. 10-01. 1-117 pp. [Online version available at <http://www.delawareestuary.org/science_projects_climate_ready_products.asp>]
- Kruchek, B.L. 2004. Use of tidal marsh and upland habitats by the marsh rice rat (*Oryzomys palustris*). *Journal of Mammalogy* 85(3):569-575.
- Kushlan, J.A. 1973. Least bittern nesting colonially. *Auk* 90:685-686.
- Kushlan, J.A., M.J. Steinkamp, K.C. Parsons, J. Capp, M.A. Cruz, M. Coulter, I. Davidson, L. Dickson, N. Edelson, R. Elliot, R.M. Erwin, S. Hatch, S. Kress, R. Milko, S. Miller, K. Mills, R. Paul, R. Phillips, J.E. Saliva, B. Sydeman, J. Trapp, J. Wheeler, and K. Wohl. 2002. Waterbird Conservation for the Americas: The North American Waterbird Conservation Plan, Version 1. Waterbird Conservation for the Americas. Washington, DC. Online version available at: http://www.waterbirdconservation.org/pdfs/plan_files/complete.pdf; accessed January 2012.
- Latham, R.E., J. Beyea, M. Benner, C.A. Dunn, M.A. Fajvan, R.R. Freed, M. Grund, S.B. Horsley, A.F. Rhoads and B.P. Shissler. 2005. Managing white-tailed deer in forest habitat from an ecosystem perspective: Pennsylvania case study. Report by the Deer Management Forum for Audubon Pennsylvania and Pennsylvania Habitat Alliance, Harrisburg. xix + 340 pp.
- Leimgruber, P., W.J. McShea, and J. Rappole. 1994. Predation on artificial nests in large forest blocks. *Journal of Wildlife Management* 58:254-260.
- Lenth, B., M. Brennan, and R.L. Knight. 2006. The effects of dogs on wildlife communities. *Natural Areas Journal* 28:218-227.
- Liddle, M. 1997. Recreation Ecology: the ecological impact of outdoor recreation and ecotourism. Chapman and Hall, Australia.
- Lippson, M.A.J., M.S. Haire, A.F. Holland, F. Jacobs, J. Jensen, R.L. Moran-Johnson, T.T. Polgar, and W.A. Richkus. 1979. Environmental atlas of the Potomac Estuary. Williams and Heintz Map Corp., Washington D.C.
- Louv, R. 2005. Last child in the woods. saving our children from nature deficit disorder. Algonquin Books. 390 pp.

- Low, D.J., D.J. Hippe, and D. Yannacci. 2002. Geohydrology of Southeastern Pennsylvania. U.S. Department of the Interior, U.S. Geological Survey, New Cumberland, PA. Water-Resources Investigations Report 00-4166. 361 pp.
- Lyons, J.E., M.C. Runge, W.L. Kendall, H. Laskowski, and S. Lor. 2005. Timing of impoundment drawdowns and impact on waterbird, invertebrate, and vegetation communities within managed wetlands. USGS Refuge Cooperative Research Program. Laurel, MD.
- Maerz, J.C., V.A. Nuzzo, and B. Blossey. Declines in woodland salamander abundance associated with non-native earthworm and plant invasions. *Conservation Biology* 23(4):975-981.
- Manci, K.M., D.N. Gladwin, R. Villela, and M.G. Cavendish. 1988. Effects of aircraft noise and sonic booms on domestic animals and wildlife: a literature synthesis. U.S. Fish and Wildlife Service, National Ecology Research Center, Ft. Collins, CO. NERC-88/29. 88 pp.
- McCormick, J., R. Grant, and R. Patrick. 1970. Two studies of Tinicum Marsh. The Conservation Foundation. 124 pp.
- McCullough, D.R. 2001. Male harvest in relation to female removals in a black-tailed deer population. *Journal of Wildlife Management* 65:46-58.
- McMenamin, M. 2008. Facility manager, John Heinz National Wildlife Refuge at Tinicum. Personal Communication.
- Meanley, B. 1969. Natural history of the king rail. *North American Fauna* 67:1-108.
- Merendino, M.T. and C.D. Ankney. 1994. Habitat use by mallards and American black ducks breeding in central Ontario. *Condor* 96:411-421.
- Meretsky, V., R. Fischman, J. Karr, D. Ashe, J. Scott, R. Noss, and R. Schroeder. 2006. New directions in conservation for the National Wildlife Refuge System. *BioScience* 56(2):135-143.
- Miller, J.C. 1982. White Ibis in Philadelphia County, Pennsylvania. *Cassinia* 59:82.
- . 1988. Birds of the Tinicum Wildlife Refuge and adjacent areas, 1970-1987. *Cassinia* 62:44-48.
- Miller, S.G., R.L. Knight, and C.K. Knight. 2001. Wildlife responses to pedestrians and dogs. *Wildlife Society Bulletin* 29:124-132.
- Mitch, W.G. and J.G. Gosselink. 1993. Wetlands. Second Edition. J. Wiley and Sons Press. pp. 267-291.
- Mitchell, L.R., C.R. Smith, and R.A. Malecki. 2000. Ecology of grassland breeding birds in the Northeastern United States: a literature review with recommendations for management. U.S. Geological Survey, Biological Resources Division, New York Cooperative Fish and Wildlife Research Unit, Department of Natural Resources. Cornell University, Ithaca, NY.
- Monaghan, A.J., D.H. Bromwich, R.L. Fogt, S.H. Wang, P.A. Mayewski, D.A. Dixon, A. Ekaykin, M. Frezzotti, I. Goodwin, E. Isaksson, S.D. Kaspan, V.I. Morgan, H. Oerter, T.D. Van Ommen, C.J. Van der Veen, and J. Wen. 2006. Insignificant change in Antarctic snowfall since the international geophysical year. *Science* 313:827-831.

- Morgan, M.R. and M.F. Burger. 2008. Monitoring the effectiveness of grassland bird conservation: efforts and perspectives from New York on developing a grassland bird monitoring program.
- Najjar, R.G., H.A. Walker, P.J. Anderson, E.J. Barron, R.J. Bord, J.R. Gibson, V.S. Kennedy, C.G. Knight, J.P. Megonigal, R.E. O'Connor, C.D. Polsky, N.P. Psuty, B.A. Richards, L.G. Sorenson, E.M. Steele, and R.S. Swanson. 2000. The potential impacts of climate change on the Mid-Atlantic Coastal Region. *Climate Research* 14:219–233.
- National Fish Habitat Action Plan (NFHAP). 2006. National fish habitat action plan April 2006. Accessed February 2011. [Online version available at <http://www.fishhabitat.org/documents/plan/National_Fish_Habitat_Action_Plan.pdf>]
- National Marine Fisheries Service (NMFS). 1998. Recovery plan for the shortnose sturgeon (*Acipenser brevirostrum*). Prepared by the Shortnose Sturgeon Recovery Team for the National Marine Fisheries Service, Silver Spring, MD. 104 pp.
- National Oceanic and Atmospheric Administration (NOAA). 1999. Mean sea level trend, Philadelphia, Pennsylvania Station 8545240.
- . 2000. Lower Darby Creek Area 33 Report for EPA Facility ID: PASFN0305521.
- . 2008. United States Historical Climatology Network (USHCN). Data from National Climate Data Center. [Online version available at: <<http://lwf.ncdc.noaa.gov/oa/climate/research/ushcn/ushcn.html>>]
- Natural Resource Conservation Service. 2009. National cooperative survey data for Delaware County, Pennsylvania. Web Soil Survey, Version 1.0. Accessed February 2009. [Online version available at <<http://websoilsurvey.nrcs.usda.gov/app/>>]
- NatureServe. 2005. Ecological association comprehensive report for red maple –sweetgum swamp. NatureServe Explorer: An online encyclopedia of life [web application]. Version 4.5. NatureServe, Arlington, VA. Accessed October 18, 2005. [Online version available at <<http://www.natureserve.org/explorer>>]
- Neitsch, S.L., J.G. Arnold, J.R. Kiniry, and J.R. Williams. 2001. Soil and water assessment tool theoretical documentation version 2000, Blackland Research Center, Texas Agricultural Experiment Station, Temple, TX.
- New Jersey Department of Environmental Protection Division of Fish and Wildlife's Office of Fish and Wildlife Health and Forensics. 2010. Epizootic hemorrhagic disease outbreak in South Jersey October 22, 2010. Accessed April 26, 2011. [Online version available at <http://www.state.nj.us/dep/fgw/news/2010/ehd_outbreak10.htm>]
- Nixon, C.M., and L.P. Hansen. 1987. Managing forests to maintain populations of gray and fox squirrels. Illinois Department of Conservation Technical Bulletin No. 5. Springfield, IL. 35 pp.
- Norment, C.J., M.C. Runge, and M.R. Morgan. 2010. Breeding biology of grassland birds in western New York: conservation and management implications. *Avian Conservation and Ecology* 5(2): 3. [Online version available at <<http://www.ace-eco.org/vol5/iss2/art3/>>]

- Northeast Regional Climate Center. 2006. Climate of Pennsylvania. U.S. comparative climate data. Ithaca, NY. [Online version available at <http://www.nrcc.cornell.edu/page_ccd.html>]
- Odum, W.E., T.J. Smith III, J.K. Hoover, and C.C. McIvor. 1984. The ecology of freshwater tidal marshes of the United States East Coast: a community profile. U. S. Fish and Wildlife Service. FWS/OBS-87/17. Washington D.C. 177 pp.
- Palmer, R.S. (editor). 1962. Handbook of North American Birds. Vol. 1. Loons through Flamingos. Yale University Press, New Haven, CT. 567 pp.
- Park, R.A., M.S. Trehan, P.W. Mausel, and R.C. Howe. 1989. The effects of sea level rise on U.S. coastal wetlands. In: The Potential Effects of Global Climate Change on the United States, Appendix B - Sea Level Rise (J. B. Smith and D. A. Tirpak, eds.), pp. 1-1 to 1-55. U.S. Environmental Protection Agency, Washington, D.C.
- Partners in Flight (PIF). 1999. Bird conservation plan for the Mid-Atlantic Coastal Plain (Physiographic Area 44), Version 1.0, April 1999. American Bird Conservancy. Williamsburg, VA.
- Partnership for Air Transportation Noise and Emissions Reduction. 2009. Aircraft impacts on local and regional air quality in the United States, PARTNER project 15 final report. Retrieved January 25, 2011. [Online version available at <<http://web.mit.edu/aeroastro/partner/reports/proj15/proj15finalreport.pdf>>]
- Paxton, R.O., W.J. Boyle, Jr., and D.A. Cutler. 1981. Hudson-Delaware region. AFN 13:422.
- Pederson, B.S. and A.M. Wallis. 2004. Effects of white-tailed deer herbivory on forest gap dynamics in a wildlife preserve, Pennsylvania, U.S.A. *Natural Areas Journal* 24:82-94.
- Pennsylvania Department of Conservation and Natural Resources (PADCNR). 2009. 2009-2013 State Comprehensive Outdoor Recreation Plan (SCORP). September 2009. [Online version available at <<http://www.paoutdoorrecplan.com/downloads.htm>>]
- . 2010a. Lowland and intermediate upland section: Atlantic Coastal Plain Province. Accessed 2010. [Online version available at <<http://www.dcnr.state.pa.us/topogeo/map13/13lius.aspx>>]
- . 2010b. Geology of Pennsylvania. Accessed December 30, 2010. [Online version available at <<http://www.dcnr.state.pa.us/topogeo/field/index.aspx>>]
- . 2010c. Emerald ash borer. Accessed June 20, 2012. [Online version available at: <http://www.dcnr.state.pa.us/forestry/fpm_invasives_EAB.aspx>]
- Pennsylvania Department of Environmental Protection (PADEP). 2011. Summary of attainment status by principal pollutants. Bureau of Air Quality. Accessed July 2011. [Online version available at <<http://www.dep.state.pa.us/dep/deputate/airwaste/aq/attain/status.htm>>]
- Pennsylvania Game Commission (PGC). Epizootic Hemorrhagic Disease (EHD) background information. Accessed January 17, 2011. [Online version available at <<http://www.portal.state.pa.us/portal/server.pt?open=514&objID=585243&mode=2>>]

- Pennsylvania Game Commission (PGC) and Pennsylvania Fish and Boat Commission (PFBC). 2008. Pennsylvania's wildlife habitat action plan, Version 1.0a. September 2005, updated May 2008. Harrisburg, PA. [Online version available at <http://www.portal.state.pa.us/portal/server.pt/document/713158/wap_2008_pt_i_pdf>]
- Pennsylvania Natural Heritage Program (PNHP). 2008. A natural heritage inventory of Philadelphia County. Western Pennsylvania Conservancy, Middletown, PA.
- Petit, L.J. and D.R. Petit. 1996. Factors governing habitat selection by prothonotary warblers: Field tests of the Fretwell-Lucas models. *Ecological Monographs* 66:367-387.
- Philadelphia Department of Health, Air Management Services (Philadelphia AMS). 2008. Philadelphia's air quality report. Department of Public Health Air Management Services. 44 pp. [Online version available at <<http://www.phila.gov/health/airmanagement>>]
- . 2010. Department Of Public Health, Environmental Health Services Air Management Services, Air Program Update, Memorandum to Air Pollution Control Board Members. November 17, 2010.
- Philadelphia International Airport (PHL). 2005. Part 150 Noise compatibility study. [Online version available at <<http://www.phl.org/noise>>]
- Philadelphia School District. 2011. About us- school district of Philadelphia, a snapshot of the District Web site. Accessed March 11, 2012. [Online version available at <<http://www.phila.k12.pa.us/about/#>>]
- Philadelphia Water Department (PWD). 2004. Darby-Cobbs watershed comprehensive characterization Report 2002 with 2004 update. [Online version available at <http://www.phillywatersheds.org/doc/DarbyCobbs_CCR.pdf>].
- Phillips, B. 2008. Refuge biologist, John Heinz National Wildlife Refuge at Tinicum. Personal Communication.
- Pinkney, A.E., J.C. Harshbarger, M.R. Roberts. 2004. Tumor prevalence in brown bullheads (*Ameiurus nebulosus*) from Darby Creek, John Heinz National Wildlife Refuge at Tinicum, Philadelphia, PA. CBFO-C04-03 and PAFO-C04-02. 37 pp.
- Reed, J.M. and L.W. Oring. 1993. Philopatry, site fidelity, dispersal, and survival of spotted sandpipers. *Auk* 110:541-551.
- Ribic, C.A., R.R. Koford, J.R. Herkert, D.H. Johnson, N.D. Niemuth, D.E. Naugle, K.K. Bakker, D.W. Sample, and R.B. Renfrew. 2009. Area sensitivity in North American grassland birds: patterns and processes. *The Auk* 126:233-244. [Online version available at <<http://www.bioone.org/doi/pdf/10.1525/auk.2009.1409>>]
- Roboski, J.C. and M.K. Causey. 1981. Incidence, habitat use, and chronology of woodcock nesting in Alabama. *Journal of Wildlife Management* 45:793-797.
- Rodgers, J.A. and H.T. Smith. 1997. Buffer zone distances to protect foraging and loafing waterbirds from human disturbance in Florida. *Wildlife Society Bulletin* 25:139-145.

- Rooney, T.P. 2001. Deer impacts on forest ecosystems: a North American perspective. *Forestry* 74:201-208.
- Roth, R.R. 1987. Assessment of habitat quality for wood thrush in a residential area. In: *Integrating Man and Nature in the Metropolitan Environment* (L.W. Adams and D.L. Leedy eds.), pp. 139-149. Proceedings of the National Symposium on Urban Wildlife, Chevy Chase, Maryland, 4-7 November, 1986. National Institute for Urban Wildlife, Columbia, MD.
- Roth, R.R., M.S. Johnson, and T.J. Underwood. 1996. Wood thrush (*Hylocichla Mustelina*). In: *The Birds of North America No. 246* (A. Poole and F. Gill, eds.). Academy of Natural Sciences, Philadelphia, and American Ornithologists' Union, Washington, DC. 28 pp.
- Rudgers, J.A. and K. Clay. 2007. Endophyte symbiosis with tall fescue: how strong are the impacts on communities and ecosystems. *Fungal Biology Reviews* 21:107-124.
- Russell, L. 2010. Where to take kids fishing near Philadelphia, Pennsylvania. *USA Today Travel*.
- Ryan, T.J. and C.T. Winne. 2001. Effects of hydroperiod on metamorphosis in *Rana sphenoccephala*. *American Midland Naturalist* 145:46-53.
- Salas, D., D.M. Williams, and R.C. Albert. 2006. Restoration management plan for the Lower Darby Creek. Delaware Riverkeeper Network. 101 pp.
- Schieck, P. and H.E. Cox. 1970. *Trolleys of Lower Delaware Valley Pennsylvania*. Harold and Cox. 86 pp.
- Schultz, R.D. and M. Stock. 1993. Kentish plovers and tourist-competitors on sandy coasts? *Wader Study Group Bulletin* 68(special issue): 83-92.
- Seavy, N.E., T. Gardali, G.H. Golet, F.T. Griggs, C.A. Howell, R. Kelsey, S.L. Small, J.H. Viers, and J.F. Weigand. 2009. Why climate change makes riparian restoration more important than ever: recommendations for practice and research. *Journal of Ecological Restoration* 27(3):330-338.
- Siemers, B. M. and A. Schaub. 2010. Hunting at the highway: traffic noise reduces foraging efficiency in acoustic predators. *Proceedings of the Royal Society: Biological Sciences*. doi: 10.1098/rspb.2010.2262. 7 pp.
- Spendelow, J.A. and S.R. Patton. 1988. National atlas of coastal waterbird colonies in the contiguous United States: 1976-1982. U.S. Fish and Wildlife Service, Biological Report 88(5). 326 pp.
- Stafford, K.C. 2007. Tick management handbook: an integrated guide for homeowners, pest control operators, and public health officials for the prevention of tick-associated disease. Revised Edition. The Connecticut Agricultural Experiment Station. Bulletin No. 1010. 84 pp.
- Stalmaster, M.V. and J.R. Newman. 1978. Behavioral responses of bald eagles to human activity. *Journal of Wildlife Management* 42:506-513.
- Stasz, J.L. 1996. Worm-eating warbler (*Helminthos vermivorus*). In: *Atlas of the Breeding Birds of Maryland and the District of Columbia* (C.S. Robbins and E.A.T. Blom, eds.), pp. 352-353. University of Pittsburgh Press, Pittsburgh, PA.

- Stewart, R.E. and C.S. Robbins. 1958. Birds of Maryland and the District of Columbia. North American Fauna No. 62. U.S. Government. Printing Office, Washington, D.C.
- Stevens, S. 1964. Pennsylvania, birthplace of a nation. Random House. New York. pp. 5, 26.
- Stiles, F.G. and A.F. Skutch. 1989. A guide to the birds of Costa Rica. Cornell University Press, Ithaca, NY. 511 pp.
- Stolz, G.L. 2009. Refuge manager, John Heinz National Wildlife Refuge at Tinicum. Personal Communication.
- Sweka, J. and J. Mohler. 2010. Fish species richness on the John Heinz National Wildlife Refuge at Tinicum. U.S. Fish and Wildlife Service, Northeast Fishery Center.
- Swift, B.L. 1987. An analysis of avian breeding habitats in Hudson river tidal marshes. New York State Department of Environmental Conservation, Division of Fish and Wildlife, Delmar, NY. Unpublished report. 62 pp.
- Syracuse Environmental Research Associates, Inc. (SERA). 2010. Triclopyr. Human Health and Ecological Risk Assessment Final Report. SERA TR-052-25-01a. July 28, 2010 Syracuse Environmental Research Assoc., Inc. Manlius, NY.
- . 2011. Glyphosate - human health and ecological risk assessment - final report submitted to U.S. Department of Agriculture, U.S. Forest Service. March 25, 2011. 336 pp. [Online version available at <http://www.fs.fed.us/foresthealth/pesticide/pdfs/Glyphosate_SERA_TR-052-22-03b.pdf>]
- Tate, G.R. and S.M. Melvin. 1987. Population dynamics, habitat use, and management needs of the short-eared owl in Massachusetts: summary of 1986 research. Massachusetts Division of Fish and Wildlife, Natural Heritage and Endangered Species Program. Unpublished report.
- Terres, J.K. 1980. The Audubon Society encyclopedia of North American birds. Alfred A. Knopf, New York.
- Thomson, K.S., W.H. Weed III, A.G. Taruski, and D.E. Simanek. 1978. Saltwater fishes of Connecticut. 2nd edition. State Geological and Natural History Survey of Connecticut, Department of Environmental Conservation, Bulletin 105. viii + 186 pp.
- Tourism Economics. 2009. The Economic Impact of Tourism in the Greater Philadelphia. April 2009. Tourism Economics, Wayne, PA. Retrieved 1/16/2011. [Online version available at <<http://www.tourismeconomics.com>>]
- Turnbull, W.P. 1869. The birds of east Pennsylvania and New Jersey, Henry Grambo and Co. Philadelphia, PA.
- Union of Concerned Scientists (UCS). 2008. Climate Change in Pennsylvania: Impacts and Solutions for the Keystone State. UCS Publications. Cambridge, MA. [Online version available at <<http://www.climatechoices.org/pa>>]
- Urban, C. 2012. Chief, Natural Diversity Section, Pennsylvania Fish and Boat Commission. Personal communication.

- U.S. Census Bureau. 2001. Profiles of general demographic characteristics: 2000 census of population and housing Pennsylvania. U.S. Department of Commerce, Economics and Statistics Administration. Accessed March 2011 [Online version available at <http://www2.census.gov/census_2000/datasets/100_and_sample_profile/Pennsylvania/>]
- . 2011a. U.S. census data from 2010. American Fact Finder Web site. U.S. Department of Commerce, Economics and Statistics Administration. Accessed August 2012 [Online version available at <<http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml>>]
- . 2011b. Population distribution and change: 2000 to 2010. U.S. Department of Commerce, Economics and Statistics Administration. Accessed March 2011 [Online version available at <<http://www.census.gov/prod/cen2010/briefs/c2010br-01.pdf>>]
- . 2011c. 2006-2010 American Community Survey 5-year estimates. American Fact Finder Web site. U.S. Department of Commerce, Economics and Statistics Administration. Accessed August 2012 [Online version available at <<http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml>>]
- U.S. Department of Agriculture (USDA). 2010. Wildlife hazard assessment and recommendations for the wildlife management plan for the Philadelphia International Airport, Philadelphia, Pennsylvania. U.S. Department of Agriculture, Animal Plant Health Inspection Service. Harrisburg, PA. 101 pp.
- U.S. Department of Agriculture, Forest Service (USFS). 1997. Glyphosate-herbicide information profile. Released February 1997.
- U.S. Department of Energy–Bonneville Power Administration (USDOE). 2000a. Triclopyr herbicide fact sheet. March 2000. 10 pp. Accessed November 2011. [Online version available at <http://efw.bpa.gov/environmental_services/Document_Library/Vegetation_Management/sheets/triclopyr.pdf>]
- . 2000b. Glyphosate herbicide fact sheet. March 2000. 12 pp. Accessed November 2011 [Online version available at <http://efw.bpa.gov/environmental_services/Document_Library/Vegetation_Management/sheets/glyphosate.pdf>]
- . 2006a. Imazapic herbicide fact sheet. March 2006. 9 pp. Accessed November 2011. [Online version available at <http://efw.bpa.gov/environmental_services/Document_Library/Vegetation_Management/sheets/Imazapic.pdf>]
- . 2006b. Aminopyralid herbicide fact sheet. March 2006. 9 pp. Accessed November 2011. [Online version available at <http://efw.bpa.gov/environmental_services/Document_Library/Vegetation_Management/sheets/aminopyralid.pdf>]
- U.S. Department of Labor. 2012. Bureau of Labor Statistics: local area unemployment statistics tables Web site. Accessed August 2012. [Online version available at <<http://www.bls.gov/lau/tables.htm>>]
- U.S. Environmental Protection Agency (USEPA). 1997. Pesticide fact sheet: Imazamox. May 22, 1997. 6 pp. Accessed November 2011. [Online version available at <<http://www.epa.gov/opprd001/factsheets/imazamox.pdf>>]

- . 1998. *Bacillus thuringiensis* subspecies *israelensis* strain EG2215 (006476) fact sheet. October 1998. [Online version available at <www.epa.gov/oppbppd1/biopesticides/ingredients/factsheets/factsheet_006476.htm>.]
- . 1999. *Bacillus sphaericus* serotype H5a5b strain 2362 (128128) fact sheet. November 1999. [Online version available at: <www.epa.gov/oppbppd1/biopesticides/ingredients/factsheets/factsheet_128128.htm>]
- . 2006. USEPA Region 3. Lower Darby Creek current site information. [Online version available at <<http://www.epa.gov/reg3hwmd/npl/PASFN0305521.htm/>>]
- . 2010. USEPA Office of Atmospheric Programs. Methane and nitrous oxide emissions from natural resources. [Online version available at <<http://www.epa.gov/outreach/pdfs/Methane-and-Nitrous-Oxide-Emissions-From-Natural-Sources.pdf>>]
- U.S. Fish and Wildlife Service (USFWS). 1981. Plymouth red-bellied turtle recovery plan. U.S. Fish and Wildlife Service. Region 5, 13 pp.
- . 1989. Refuge manual volumes I and II. National Wildlife Refuge System, Washington Office, Arlington, VA.
- . 1999. Fulfilling the promise: the National Wildlife Refuge System. U.S. Fish and Wildlife Service, Arlington, VA.
- . 2003. Biological integrity, diversity, and environmental health. USFWS Policy 601 FW3. U.S. Fish and Wildlife Service, Arlington, VA.
- . 2004. The national strategy for managing invasive species. National Invasive Species Management Strategy Team. U.S. Fish and Wildlife Service, Arlington, VA. [Online version available at <<http://www.fws.gov/invasives/pdfs/NationalStrategyFinalRevised05-04.pdf>>]
- . 2007a. John Heinz National Wildlife Refuge avian influenza surveillance and disease contingency plan.
- . 2007b. John Heinz National Wildlife Refuge chronic wasting disease surveillance and disease contingency plan.
- . 2008a. New England Mid-Atlantic Coast Bird Conservation Region (BCR 30) implementation plan. Atlantic Coast Joint Venture, Hadley, MA: Region 5, Fish and Wildlife Service, U.S. Department of the Interior. [Online version available at <http://www.acjv.org/BCR_30/BCR30_June_23_2008_final.pdf>]
- . 2008b. Birds of Conservation Concern 2008. U.S. Department of Interior, U.S. Fish and Wildlife Service, Division of Migratory Bird Management. Arlington, VA. 85 pp. [Online version available at <<http://www.fws.gov/migratorybirds/>>]
- . 2009a. North Atlantic Landscape Conservation Cooperative development and operations plan. December 2009. U.S. Department of Interior, U.S. Fish and Wildlife Service, Northeast Region. Hadley, MA. 38 pp.
- . 2009b. John Heinz National Wildlife Refuge Web site. Accessed April 2009. [Online version available at <<http://www.fws.gov/northeast/heinz/>>]
- . 2010. Service Manual. Division of Policy and Directives Management. Accessed December 30, 2010. [Online version available at <<http://www.fws.gov/policy/manuals/>>]

- . 2011. Conserving the future, wildlife refuges and the next generation. October 2011. U.S. Fish and Wildlife Service, The National Wildlife Refuge System, Washington DC. 93pp.
- U.S. Geological Survey (USGS). 2009. Pennsylvania StreamStats Data Obtained for Darby Creek within the John Heinz National Wildlife Refuge at Tinicum location. Data accessed April 2009. [Online version available at <<http://water.usgs.gov/osw/streamstats/pennsylvania.html>>]
- . 2011. Avian botulism. Accessed June 2012. [Online version available at <http://www.nwhc.usgs.gov/disease_information/avian_botulism/>]
- VanBeusichem, A., J. Hill, A. Hodges, and T. Comish. 2009. John Heinz National Wildlife Refuge at Tinicum visitor services review. U.S. Fish and Wildlife Service, Region 5, Hadley, MA. 19pp.
- VanDervort-Sneed, J. 2010. Environmental review specialist, Pennsylvania Department of Conservation and Natural Resources. Personal Communication.
- Walters, R.A. 1992. A three-dimensional, finite element model for coastal and estuarine circulation. *Continental Shelf Research* 12:83-102.
- Watling, J.I., C.R. Hickman, and J.L. Orrock. 2011. Invasive shrub alters native forest amphibian communities. *Biological Conservation* 144:2597-2601.
- Warren Pinnacle Consulting, Inc. 2011. SLAMM: Sea Level Affecting Marshes Model. [Online version available at <<http://warrenpinnacle.com/prof/SLAMM/>>]
- Weston, N.B., R.E. Dixon, and S.B. Joye. 2006. Ramifications of increased salinity in tidal freshwater sediments: geochemistry and microbial pathways of organic matter mineralization. *Journal of Geophysical Research* 111, G01009, doi:10.1029/2005JG000071.
- Weston, N.B., J.T. Hollibaugh, and S.B. Joye. 2009. Population growth away from the coastal zone. Thirty years of land use change and nutrient export in the Altamaha River, GA. *Science of the Total Environment* 407:3347-3356.
- Weller, M.W. 1961. Breeding biology of the least bittern. *Wilson Bulletin* 73:11-35.
- Wells, M. and D. White. 2011. Environmental Education Stakeholder Analysis Report–Phase II. Unpublished report prepared for John Heinz National Wildlife Refuge at Tinicum, Philadelphia, PA. Prepared by Wells Resources, Inc. 42 pp.
- Westervelt, K., E. Largay, R. Coxe, W. McAvoy, S. Perles, G. Podniesinski, L. Sneddon, and K. Walz. 2006. A guide to the natural communities of the Delaware Estuary: Version I. NatureServe, Arlington, VA.
- Wilcove, D.S., D. Rothstein, J. Dubow, A. Phillips, and E. Losos. 1998. Quantifying threats to imperiled species in the United States. *BioScience* 48:607–617.
- Williams, B.K., R.C. Szaro, and C.D. Shapiro. 2009. Adaptive management: the U.S. Department of the Interior technical guide. U.S. Department of the Interior, Adaptive Management Working Group, Washington, DC. [Online version available at <<http://www.doi.gov/initiatives/AdaptiveManagement/documents.html>>]

- VanDervort-Sneed, J. 2010. Environmental Review Specialist, Pennsylvania Department of Conservation and Natural Resources. Personal Communication.
- Walters, R.A. 1992. A three-dimensional, finite element model for coastal and estuarine circulation. *Continental Shelf Research* 12, 83-102.
- Watling, J.I., C.R. Hickman, and J.L. Orrock. 2011. Invasive shrub alters native forest amphibian communities. *Biological Conservation* 144:2597-2601.
- Warren Pinnacle Consulting, Inc. 2011. SLAMM: Sea Level Affect Marshes Model. [Online version available at <http://warrenpinnacle.com/prof/SLAMM/>]
- Weston, N.B., R.E. Dixon, and S.B. Joye. 2006. Ramifications of increased salinity in tidal freshwater sediments: Geochemistry and microbial pathways of organic matter mineralization. *Journal of Geophysical Research* 111, G01009, doi:10.1029/2005JG000071.
- Weston, N.B., J.T. Hollibaugh, and S.B. Joye. 2009. Population growth away from the coastal zone. Thirty years of land use change and nutrient export in the Altamaha River, GA. *Science of the Total Environment* 407:3347-3356.
- Weller, M.W. 1961. Breeding biology of the least bittern. *Wilson Bulletin*. 73:11-35.
- Wells, M. and D. White. 2011. Environmental Education Stakeholder Analysis Report–Phase II. Unpublished report prepared for John Heinz National Wildlife Refuge at Tinicum, Philadelphia, PA. Prepared by Wells Resources, Inc. 42 pp.
- Westervelt, K., E. Largay, R. Coxe, W. McAvoy, S. Perles, G. Podniesinski, L. Sneddon, and K. Walz. 2006. A Guide to the Natural Communities of the Delaware Estuary: Version I. NatureServe, Arlington, Virginia.
- Wilcove, D.S., D. Rothstein, J. Dubow, A. Phillips, and E. Losos. 1998. Quantifying threats to imperiled species in the United States. *BioScience*. 48:607–617.
- Williams, B.K., R.C. Szaro, and C.D. Shapiro. 2009. Adaptive Management: The U.S. Department of the Interior Technical Guide. Adaptive Management Working Group, U.S. Department of the Interior, Washington, DC. [Online version available at <<http://www.doi.gov/initiatives/AdaptiveManagement/documents.html>>]

Glossary and Acronyms

Greg Thompson/USFWS



White-tailed deer yearling

Glossary and Acronyms

Glossary

accessibility	the state or quality of being easily approached or entered, particularly as it relates to complying with the Americans With Disabilities Act.
accessible facilities	structures accessible for most people with disabilities without assistance; facilities that meet UFAS standards; ADA-accessible [e.g., parking lots, trails, pathways, ramps, picnic and camping areas, restrooms, boating facilities (docks, piers, gangways), fishing facilities, playgrounds, amphitheaters, exhibits, audiovisual programs, and wayside sites].
aggregate	many parts considered together as a whole.
agricultural land	non-forested land (now or recently orchards, pastures, or crops).
alternative	a reasonable way to fix an identified problem or satisfy a stated need [40 CFR 1500.2] (see “management alternative”).
anthropogenic	caused or produced by humans.
appropriate use	<p>a proposed or existing use on a refuge that meets at least one of the following three conditions:</p> <ol style="list-style-type: none"> 1. the use is a wildlife-dependent one. 2. the use contributes to fulfilling the refuge purpose(s), the System mission, or goals or objectives described in a refuge management plan approved after October 9, 1997, the date the National Wildlife Refuge System Improvement Act was signed into law. 3. the use has been determined appropriate as specified in the policy.
approved acquisition boundary	a project boundary that the Director of the U.S. Fish and Wildlife Service approves upon completion of the planning and environmental compliance process. An approved acquisition boundary only designates those lands which the Service has authority to acquire or manage through various agreements. The approval of an acquisition boundary does not grant the Service jurisdiction or control over lands within the boundary, and it does not make lands within the refuge boundary part of the National Wildlife Refuge System. Lands do not become part of the Refuge System until the Service buys them or they are placed under an agreement that provides for their management as part of the Refuge System.
aquatic	growing in, living in, or dependent upon water.
area of biological significance	see “special focus area.”
best management practices	<p>land management practices that produce desired results.</p> <p>[N.b. Usually describing forestry or agricultural practices effective in reducing non point source pollution, like reseeding skidder trails or not storing manure in a flood plain. In their broader sense, practices that benefit target species.]</p>

biological diversity or biodiversity	the variety of life and its processes and includes the variety of living organisms, the genetic differences among them, and the communities and ecosystems in which they occur.
biological integrity	biotic composition, structure, and functioning at genetic, organism, and community levels comparable with historic conditions, including the natural biological processes that shape genomes, organisms and communities.
breeding habitat	habitat used by migratory birds or other animals during the breeding season.
categorical exclusion (CE, CX, CATEX, CATX)	pursuant to the National Environmental Policy Act (NEPA), a category of Federal agency actions that do not individually or cumulatively have a significant effect on the human environment [40 CFR 1508.4].
CFR	the Code of Federal Regulations.
community	an assemblage of plants occurring together at any point in time.
community type	a particular assemblage of plants and animals, named for its dominant characteristic.
compatible use	“The term ‘compatible use’ means a wildlife-dependent recreational use or any other use of a refuge that, in the sound professional judgment of the Director, will not materially interfere with or detract from the fulfillment of the mission of the System or the purposes of the refuge.”—National Wildlife Refuge System Improvement Act of 1997 [Public Law 105-57; 111 Stat. 1253].
compatibility determination	a required determination for wildlife-dependent recreational uses or any other public uses of a refuge.
comprehensive conservation plan (CCP)	mandated by the Refuge Improvement Act, a document that provides a description of the desired future conditions and long-range guidance for the project leader to accomplish purposes of the refuge system and the refuge. CCPs establish management direction to achieve refuge purposes [P.L. 105-57; USFWS Manual 602 FW 1.4].
concern	see “issue.”
conservation	managing natural resources to prevent loss or waste. [N.b. Management actions may include preservation, restoration, and enhancement.]
conservation easement	a legal agreement between a landowner and a land trust (e.g., a private, nonprofit conservation organization) or government agency that permanently limits the uses of a property to protect its conservation values.
cool-season grass	introduced grass for crop and pastureland that grows in spring and fall and is dormant during hot summer months.
cooperative agreement	a usually long-term habitat protection action which can be modified by either party, in which no property rights are acquired. Lands under a cooperative agreement do not necessarily become part of the National Wildlife Refuge System.

critical habitat	according to U.S. Federal law, the ecosystems upon which endangered and threatened species depend.
cultural resources	archaeological sites, historic structures, and historic landscapes.
cultural resource overview	a comprehensive document prepared for a field office that discusses, among other things, project prehistory and cultural history, the nature and extent of known cultural resources, previous research, management objectives, resource management conflicts or issues, and a general statement of how program objectives should be met and conflicts resolved. [An overview should reference or incorporate information from a field office's background or literature search described in section VIII of the Cultural Resource Management Handbook (cf. USFWS Manual 614 FW 1.7).]
database	a collection of data arranged for ease and speed of analysis and retrieval, usually computerized.
degradation	the loss of native species and processes due to human activities such that only certain components of the original biodiversity persist, often including significantly altered natural communities.
designated wilderness area	an area designated by Congress as part of the National Wilderness Preservation System [USFWS Manual 610 FW 1.5 9 draft].
digitizing	the process of converting maps into geographically referenced electronic files for a geographic information system (GIS).
disturbance	any relatively discrete event in time that disrupts ecosystem, community, or population structure and changes resources, substrate availability, or the physical environment.
donation	a citizen or group may wish to give land or interests in land to the Service for the benefit of wildlife. Aside from the cost factor, these acquisitions are no different than any other means of land acquisition. Gifts and donations have the same planning requirements as purchases.
easement	an agreement by which landowners give up or sell one of the rights on their property (e.g., landowners may donate rights-of-way across their properties to allow community members access to a river). See "conservation easement."
ecological processes	a complex mix of interactions among animals, plants, and their environment that ensures maintenance of an ecosystem's full range of biodiversity. Examples include population and predator-prey dynamics, pollination and seed dispersal, nutrient cycling, migration, and dispersal.
ecoregion	a territory defined by a combination of biological, social, and geographic criteria, rather than geopolitical considerations; generally, a system of related, interconnected ecosystems.
ecosystem	a natural community of organisms interacting with its physical environment, regarded as a unit.

ecotourism	visits to an area that maintains and preserves natural resources as a basis for promoting its economic growth and development.
emergent wetland	wetlands dominated by erect, rooted, herbaceous plants.
endangered species	a federally or state-listed protected species in danger of extinction throughout all or a significant portion of its range.
endophyte	a bacterium or fungus that lives within a plant for at least part of its life without causing apparent disease.
environmental education	curriculum-based education aimed at producing a citizenry that is knowledgeable about the biophysical environment and its associated problems, aware of how to help solve those problems, and motivated to work toward solving them.
environmental health	the composition, structure, and functioning of soil, water, air, and other abiotic features comparable with historic conditions, including the natural abiotic processes that shape the environment.
Environmental Assessment (EA)	a public document that discusses the purpose and need for an action, its alternatives, and provides sufficient evidence and analysis of its impacts to determine whether to prepare an environmental impact statement or a finding of no significant impact (q.v.) [cf. 40 CFR 1508.9].
exemplary community type	an outstanding example of a particular community type.
extirpated	status of a species or population that has completely vanished from a given area but that continues to exist in some other location.
exotic species	a species that is not native to an area and has been introduced intentionally or unintentionally by humans; not all exotics become successfully established.
Federal land	public land owned by the Federal Government, including national forests, national parks, and national wildlife refuges.
federally listed species	a species listed either as endangered or threatened under the Endangered Species Act of 1973, as amended.
fee-title acquisition	the acquisition of most or all of the rights to a tract of land; a total transfer of property rights with the formal conveyance of a title. While a fee-title acquisition involves most rights to a property, certain rights may be reserved or not purchased, including water rights, mineral rights, or use reservation (e.g., the ability to continue using the land for a specified time period, such as the remainder of the owner's life).
Finding of No Significant Impact (FONSI)	supported by an environmental assessment, a document that briefly presents why a Federal action will have no significant effect on the human environment, and for which an environmental impact statement, therefore, will not be prepared [40 CFR 1508.13].
fire regime	the characteristic frequency, intensity, and spatial distribution of natural fires within a given ecoregion or habitat.

floodplain	flat or nearly flat land that may be submerged by floodwaters; a plain built up or in the process of being built up by stream deposition.
focus areas	see “special focus areas” .
forested land	land dominated by trees. For impacts analysis in CCP’s, we assume all forested land has the potential for occasional harvesting; we assume forested land owned by timber companies is harvested on a more intensive, regular schedule.
forested wetlands	wetlands dominated by trees.
fragmentation	the disruption of extensive habitats into isolated and small patches. Fragmentation has two negative components for biota: the loss of total habitat area and the creation of smaller, more isolated patches of habitat remaining.
geographic information system (GIS)	a computerized system to compile, store, analyze, and display geographically referenced information (e.g., GIS can overlay multiple sets of information on the distribution of a variety of biological and physical features).
grassland	a habitat type with landscapes dominated by grasses and with biodiversity characterized by species with wide distributions, communities being relatively resilient to short-term disturbances but not too prolonged, and intensive burning or grazing. In such systems, larger vertebrates, birds, and invertebrates display extensive movement to track seasonal or patchy resources.
groundwater	water in the ground that is in the zone of saturation, from which wells and springs and groundwater runoff are supplied.
habitat fragmentation	the breaking up of a specific habitat into isolated and small patches. [N.b. A habitat area that is too small may not provide enough space to maintain a breeding population of the species in question.]
habitat conservation	protecting an animal or plant habitat to ensure that the use of that habitat by the animal or plant is not altered or reduced.
habitat	the place where a particular type of plant or animal lives. [N.b. An organism’s habitat must provide all of the basic requirements for life, and should be free of harmful contaminants.]
historic conditions	the composition, structure, and functioning of ecosystems resulting from natural processes that we believe, based on sound professional judgment, were present prior to substantial human-related changes to the landscape.
hydrologic or flow regime	characteristic fluctuations in river flows.
hydrology	the science of waters of the earth: their occurrences, distributions, and circulations; their physical and chemical properties; and their reactions with the environment, including living beings.
impoundment	a body of water, such as a pond, confined by a dam, dike, floodgate, or other barrier, which is used to collect and store water for future use.

indigenous	native to an area.
interpretive facilities	structures that provide information about an event, place, or thing by a variety of means, including printed, audiovisual, or multimedia materials (e.g., kiosks that offer printed materials and audiovisuals, signs, and trail heads).
interpretive materials	any tool used to provide or clarify information, explain events or things, or increase awareness and understanding of the events or things (e.g., printed materials like brochures, maps or curriculum materials; audio/visual materials like video and audio tapes, films, or slides; and, interactive multimedia materials, CD ROM or other computer technology).
invasive species	a non-indigenous species whose introduction causes or is likely to cause economic or environmental harm or harm to human health.
invertebrate	any animal lacking a backbone or bony segment that encloses the central nerve cord.
issue	<p>any unsettled matter that requires a management decision (e.g., a Service initiative, an opportunity, a management problem, a threat to the resources of the unit, a conflict in uses, a public concern, or the presence of an undesirable resource condition).</p> <p>[N.b. A CCP should document, describe, and analyze issues even if they cannot be resolved during the planning process (FWS Manual 602 FW 1.4).]</p>
Land Protection Plan (LPP)	a document that identifies and prioritizes lands for potential Service acquisition from a willing seller, and describes other methods of providing protection. Landowners within project boundaries will find this document, which is released with environmental assessments, most useful.
land trusts	organizations dedicated to conserving land by purchase, donation, or conservation easement from landowners.
landscape	an aggregate of landforms, together with its biological communities.
management alternative	a set of objectives and the strategies needed to accomplish each objective [FWS Manual 602 FW 1.4].
management concern	see “issue” and “migratory nongame birds of management concern.”
management opportunity	see “issue.”
management plan	<p>a plan that guides future land management practices on a tract.</p> <p>[N.b. In the context of an environmental impact statement, management plans may be designed to produce additional wildlife habitat along with primary products like timber or agricultural crops (see “cooperative agreement”).]</p>
management strategy	<p>a general approach to meeting unit objectives.</p> <p>[N.b. A strategy may be broad, or it may be detailed enough to guide implementation through specific actions, tasks, and projects (FWS Manual 602 FW 1.4).]</p>

mesic soil	sandy-to-clay loams containing moisture-retentive organic matter, well-drained (no standing water).
mission statement	a succinct statement of the purpose for which the unit was established; its reason for being.
mitigation	actions to compensate for the negative effects of a particular project (e.g., wetland mitigation usually restores or enhances a previously damaged wetland or creates a new wetland).
National Environmental Policy Act of 1969 (NEPA)	42 U.S.C. 4321 et seq. requires all Federal agencies to examine the environmental impacts of their actions, incorporate environmental information, and use public participation in planning and implementing environmental actions. Federal agencies must integrate NEPA with other planning requirements, and prepare appropriate NEPA documents to facilitate better environmental decisionmaking (cf. 40 CFR 1500).
National Wildlife Refuge System (Refuge System)	all lands and waters and interests therein administered by the Service as wildlife refuges, wildlife ranges, wildlife management areas, waterfowl production areas, and other areas for the protection and conservation of fish and wildlife, including those that are threatened with extinction.
native	a species that, other than as a result of an introduction, historically occurred or currently occurs in a particular ecosystem.
native plant	a plant that has grown in the region since the last glaciation, and occurred before European settlement.
natural disturbance event	any natural event that significantly alters the structure, composition, or dynamics of a natural community (e.g., floods, fires, and storms).
non-consumptive, wildlife-oriented recreation	wildlife observation and photography and environmental education and interpretation (see “wildlife-dependent recreation”).
nonnative species	see “exotic species.”
nonpoint source pollution	a diffuse form of water quality degradation in which wastes are not released at one specific, identifiable point but from diffuse sources or a number of points that are spread out and difficult to identify and control.
non-forested wetlands	wetlands dominated by shrubs or emergent vegetation.
Notice of Intent (NOI)	an announcement we publish in the <i>Federal Register</i> that we will prepare and review an environmental impact statement or an environmental assessment [40 CFR 1508.22].
Notice of Availability (NOA)	an announcement we publish in the <i>Federal Register</i> that we have prepared an environmental impact statement or an environmental assessment and that it is available for public review and comment.
objective	see “unit objective.”

old fields	areas formerly cultivated or grazed, where woody vegetation has begun to invade. [N.b. If left undisturbed, old fields will eventually succeed into forest. Many occur at sites marginally suitable for crops or pasture. They vary markedly in the Northeast, depending on soil and land use and management history.]
outdoor education	educational activities that take place in an outdoor setting.
partnership	a contract or agreement among two or more individuals, groups of individuals, organizations, or agencies, in which each agrees to furnish a part of the capital or some service in kind (e.g., labor) for a mutually beneficial enterprise.
payment in lieu of taxes	cf. Revenue Sharing Act of 1935, Chapter One, Legal Context.
point source	a source of pollution that involves discharge of waste from an identifiable point, such as a smokestack or sewage-treatment plant outfall pipe.
population monitoring	assessing the characteristics of populations to ascertain their status and establish trends on their abundance, condition, distribution, or other characteristics.
prescribed fire	the application of fire to wildland fuels, either by natural or intentional ignition, to achieve identified land use objectives [FWS Manual 621 FW 1.7].
priority public use	a compatible wildlife-dependent recreational use of a refuge involving hunting, fishing, wildlife observation or photography, or environmental education or interpretation.
private land	land owned by a private individual or group or nongovernmental organization.
private landowner	see “private land.”
private organization	any nongovernmental organization.
protection	mechanisms like fee title acquisition, conservation easements, or binding agreements with landowners that ensure land use and land management practices will remain compatible with maintaining species populations at a site.
public	individuals, organizations, and nongovernment groups; officials of Federal, state, and local government agencies; Native American Tribes, and foreign nations includes anyone outside the core planning team, those who may or may not have indicated an interest in the issues, and those who do or do not realize that our decisions may affect them.
public involvement	offering an opportunity to interested individuals and organizations whom our actions or policies may affect to become informed; soliciting their individual opinions. We thoroughly study public input, and give it thoughtful consideration in shaping decisions about managing refuges.
public land	land owned by the local, state, or Federal Government.
rare species	species identified for special management emphasis because of their uncommon occurrence within a watershed.

rare community types	plant community types classified as rare by any state program; includes exemplary community types.
refuge goals	According to “Writing Refuge Management Goals and Objectives: A Handbook,” refuge goals are “...descriptive, open-ended, and often broad statements of desired future conditions that convey a purpose but do not define measurable units.”
refuge purposes	According to the National Wildlife Refuge System Improvement Act of 1997, “The terms ‘purposes of the refuge’ and ‘purposes of each refuge’ mean the purposes specified in or derived from the law, proclamation, executive order, agreement, public land order, donation document, or administrative memorandum establishing, authorizing, or expanding a refuge, refuge unit, or refuge subunit.”
refuge lands	lands in which the Service holds full interest in fee title or partial interest like an easement.
restoration	management of a disturbed or degraded habitat that results in the recovery of its original state (e.g., restoration may involve planting native grasses and forbs, removing shrubs, prescribed burning, or reestablishing habitat for native plants and animals on degraded grassland).
riparian	referring to the interface between freshwater habitats and the terrestrial landscape.
riparian habitat	habitat along the banks of a stream or river (see note above).
riverine	within the active channel of a river or stream.
riverine wetlands	generally, all the wetlands and deepwater habitats occurring within a freshwater river channel not dominated by trees, shrubs, or persistent emergents.
runoff	water from rain, melted snow, or agricultural or landscape irrigation that flows over a land surface into a water body (see “urban runoff”).
Service presence	Service programs and facilities that it directs or shares with other organizations; public awareness of the Service as a sole or cooperative provider of programs and facilities
shrublands	habitats dominated by various species of shrubs, often with many grasses and forbs.
species of concern or species of conservation concern	species not federally listed as threatened or endangered, but about which we or our partners are concerned.
species diversity	usually synonymous with “species richness,” but may also include the proportional distribution of species.
species richness	a simple measure of species diversity calculated as the total number of species in a habitat or community.
state agencies	natural resource agencies of state governments.
state land	state-owned public land.

state-listed species	see “federally listed species.”
step-down management plan	a plan for dealing with specific refuge management subjects, strategies, and schedules, e.g., cropland, wilderness, and fire [FWS Manual 602 FW 1.4.].
strategy	a specific action, tool, technique, or combination of actions, tools, and techniques for meeting unit objectives.
succession	the natural, sequential change of species composition of a community in a given area.
surface water	all waters whose surface is naturally exposed to the atmosphere, or wells or other collectors directly influenced by surface water.
sustainable development	the attempts to meet economic objectives in ways that do not degrade the underlying environmental support system. Note that there is considerable debate over the meaning of this term; we define it as “human activities conducted in a manner that respects the intrinsic value of the natural world, the role of the natural world in human well-being, and the need for humans to live on the income from nature’s capital rather than the capital itself.”
terrestrial	living on land.
threatened species	a federally listed, protected species that is likely to become an endangered species in the foreseeable future over all or a significant portion of its range.
tributary	a stream or river that flows into a larger stream, river, or lake, feeding it water.
trust resource	<p>a resource that the Government holds in trust for the people through law or administrative act.</p> <p>[N.b. A Federal trust resource is one for which responsibility is given wholly or in part to the Federal Government by law or administrative act. Generally, Federal trust resources are nationally or internationally important no matter where they occur, like endangered species or migratory birds and fish that regularly move across state lines. They also include cultural resources protected by Federal historic preservation laws, and nationally important or threatened habitats, notably wetlands, navigable waters, and public lands like s national wildlife refuges.]</p>
unfragmented habitat	large, unbroken blocks of a particular type of habitat.
upland	dry ground (i.e., other than wetlands).
upland meadow or pasture	<p>upland pastures are areas maintained in grass for livestock grazing; upland meadows are hay production areas.</p> <p>[N.b. Meadows may occur naturally in tidal marshes and inland flooded river valleys or, more frequently, at upland sites where vegetation has been cleared and grasses planted. Eventually, meadows will revert to old fields and forest if they are not mowed, grazed, or burned. Grasses in both managed meadows and pastures usually are similar, but pasture herbs often differ because of selective grazing.]</p>
urban runoff	water from rain, melted snow, or landscape irrigation flowing from city streets and domestic or commercial properties that may carry pollutants into a sewer system or water body.

vernal pool	depressions holding water for a temporary period in the spring, and in which various amphibians lay eggs.
vision statement	a concise statement of what the refuge could achieve in the next 10 to 15 years.
watershed	the geographic area within which water drains into a particular river, stream, or body of water. A watershed includes both the land and the body of water into which the land drains.
wetlands	lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. These areas are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support a prevalence of vegetation typically adapted to life in saturated soil conditions.
wilderness study areas	lands and waters identified by inventory as meeting the definition of wilderness and being evaluated for a recommendation that they be included in the designated wilderness area.
wilderness	see “designated wilderness area.”
wildfire	a free-burning fire requiring a suppression response; all fire other than prescribed fire that occurs on wildlands [FWS Manual 621 FW 1.7].
wildlife-dependent recreation	recreational activities in which wildlife is the focus of the experience. According to the National Wildlife Refuge Improvement Act of 1997, “The terms ‘wildlife-dependent recreation’ and ‘wildlife-dependent recreational use’ mean a use of a refuge involving hunting, fishing, wildlife observation or photography, or environmental education or interpretation.”
wildlife-dependent recreational use	a use of a national wildlife refuge involving hunting, fishing, wildlife observation or photography, or environmental education or interpretation (National Wildlife Refuge System Administration Act of 1966).
wildlife management	manipulating wildlife populations, either directly by regulating the numbers, ages, and sex ratios harvested, or indirectly by providing favorable habitat conditions and alleviating limiting factors.

Acronyms

Acronym	Full Name
ADA	Americans with Disabilities Act
ATV	All-terrain Vehicle
BCR	Bird Conservation Region
BIDEH	Biological Diversity, Integrity, and Environmental Health
CCP	Comprehensive Conservation Plan
CD	Compatibility Determination
CFR	Code of Federal Regulations
CWD	Chronic Wasting Disease
DNL	Day-night Average Sound Level
EA	Environmental Assessment
EHD	Epizootic Hemorrhagic Disease
USEPA	United States Environmental Protection Agency
FONSI	Finding of No Significant Impact
GIS	Geographic Information System
HMP	Habitat Management Plan
IPCC	Intergovernmental Panel on Climate Change
LWCF	Land and Water Conservation Fund
MBCF	Migratory Bird Conservation Fund
NEPA	National Environmental Policy Act
NOAA	National Oceanic and Atmospheric Administration
NWPS	National Wilderness Preservation System
NWR	National Wildlife Refuge
NWRS	National Wildlife Refuge System
PADCNR	Pennsylvania Department of Conservation and Natural Resources
PADEP	Pennsylvania Department of Environmental Protection
PENNDOT	Pennsylvania Department of Transportation
PFBC	Pennsylvania Fish and Boat Commission
PGC	Pennsylvania Game Commission

Acronym	Full Name
PIF	Partners in Flight
PWD	Philadelphia Water Department
rSETs	Rod-Surface Elevation Tables
RONS	Refuge Operating Needs System
SAMMS	Service Asset Maintenance Management System
SEPTA	Southeastern Pennsylvania Transportation Authority
SETs	Surface Elevation Tables
SLAMM	Sea Level Affecting Marshes Model
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WIA	Wilderness Inventory Area
WSA	Wilderness Study Area

Appendix A

Frank Miles/USFWS



A pine warbler in the refuge's coastal plain forest habitat

Known Species of Conservation Concern

Species	Seasons/Abundance at John Heinz NWR ¹				Nesting ¹	Federal T&E ²	PA T&E ³	BCR 30 ⁴	PIF 44 ⁵	USFWS North Atlantic LCC Priority List ⁶	USFWS Birds of Conserv. Concern ⁷	Federal Trust Fish	PA SWAP Priority ⁸	North Atlantic Shorebird Plan ⁹	North American Waterbird Plan ¹⁰	Waterfowl Management Plan ¹¹
	Spr	Sum	Fall	Win												
WATERBIRDS																
American Bittern	c	r	o	r	Y		PE	M	2		X		HC			
American Coot	c	o	c	o	Y								MC			
Black Tern	o	r	o				PE								M	
Black-crowned Night Heron	a	a	a	o	Y		PE	M					V		M	
Bonaparte's Gull	o	r	o	r											M	
Caspian Tern	o	r	o						5						L	
Cattle Egret	o	o	r												NR	
Common Moorhen	u	u	u	r	Y				5				MC			
Common Tern	r	r	r				PE	M					V		L	
Double-crested Cormorant	c	r	c	r											NR	
Forster's Tern	r	o	c						5						M	
Glaucous Gull	r		r	r											NR	
Glossy Ibis	o	o	o					H	5						L	
Great Blue Heron	a	c	a	c					5				MC		NR	
Great Egret	a	a	a	r	Y		PE		5				V		NR	
Gull-billed Tern			r					HH	2	X	X				H	
Herring Gull	c	o	c	c											L	
Horned Grebe	r		r	r				H			X					
Iceland Gull	r		r	r											L	
King Rail	o	o	o	r	Y		PE	M	1B				V			
Laughing Gull	o	o	c	r											NR	
Least Bittern	o	c	o		Y		PE		2		X		V			
Least Tern	r	r	r					H	2		X				H	
Little Blue Heron	o	c	c					M	5						H	
Northern Gannet			r	r				H							NR	

Species	Seasons/Abundance at John Heinz NWR ¹				Nesting ¹	Federal T&E ²	PA T&E ³	BCR 30 ⁴	PIF 44 ⁵	USFWS North Atlantic LCC Priority List ⁶	USFWS Birds of Conserv. Concern ⁷	Federal Trust Fish	PA SWAP Priority ⁸	North Atlantic Shorebird Plan ⁹	North American Waterbird Plan ¹⁰	Waterfowl Management Plan ¹¹
	Spr	Sum	Fall	Win												
WATERBIRDS (cont.)																
Pied-billed Grebe	c	r	c	o	Y				5		X		MC			
Red-throated Loon			r	r				HH			X					
Ring-billed Gull	c	o	c	c											NR	
Royal Tern			r					M	5						M	
Snowy Egret	a	a	a		Y			M			X				H	
Sora	o	o	o	r	Y			M					MC			
Tricolored Heron	o	o	o					M	5						H	
Virginia Rail	o	o	o	r	Y								HC			
White Ibis	r		r												M	
Yellow-crowned Night Heron	r	r	r				PE	M	5				V		M	
WATERFOWL																
American Black Duck	a	c	a	c	Y			HH	1B	X			MC			D
American Wigeon	o		o	o				M								I
Blue-winged Teal	c	c	c	r	Y											I
Brant	r		r	r						X						
Bufflehead	o		o	r				H								I
Canada Goose	a	a	a	c	Y					X						
Canvasback	o		o	r				H								I
Common Goldeneye	r	r	r	r				M								
Common Merganser	o		o	o												I
Gadwall	o	r	o	o				M								I
Greater Scaup	c	r	o	o				H								I
Green-winged Teal	c	o	a	c	Y			M					V			I
Hooded Merganser	o	r	o	r	Y			M								I
Lesser Scaup	o		o	o				H								D
Mallard	a	a	a	c	Y			H								NT

Species	Seasons/Abundance at John Heinz NWR ¹				Nesting ¹	Federal T&E ²	PA T&E ³	BCR 30 ⁴	PIF 44 ⁵	USFWS North Atlantic LCC Priority List ⁶	USFWS Birds of Conserv. Concern ⁷	Federal Trust Fish	PA SWAP Priority ⁸	North Atlantic Shorebird Plan ⁹	North American Waterbird Plan ¹⁰	Waterfowl Management Plan ¹¹
	Spr	Sum	Fall	Win												
WATERFOWL (cont.)																
Northern Pintail	c	o	c	c	Y			M								D
Northern Shoveler	c	r	c	o	Y											I
Red-breasted Merganser	o		r	r				M								I
Redhead	r	r	r	r												NT
Ring-necked Duck	o	r	o	o												I
Ruddy Duck	c	o	c	c				M					MC			I
Tundra Swan	r		r	r				H					R			
Wood Duck	a	c	a	o	Y			M								I
LANDBIRDS																
Acadian Flycatcher	r	r	u						1B				MC			
Alder Flycatcher	o	o	u		Y								MC			
American Kestrel	c	c	c	c	Y				2							
Bald Eagle	u	r	u	u	Y		PT	M	5		X		HC			
Bank Swallow	c	o	c						5				MC			
Barn Owl	c	c	c	c	Y		CR		2				MC			
Barred Owl	r	r	r	r					5							
Bay-breasted Warbler	c	r	c					H		X	X					
Black-and-white Warbler	c	r	c	r				H								
Black-billed Cuckoo	o	o	o		Y								MC			
Blackburnian Warbler	c	r	c					M					MC			
Blackpoll Warbler	c	r	c				PE						V			
Black-throated Blue Warbler	c	r	c										MC			
Black-throated Green Warbler	c	r	c										MC			
Blue-winged Warbler	o	o	o					HH	1B	X	X		R			
Bobolink	o	r	c						5							
Brewer's Blackbird			r	r												

Species	Seasons/Abundance at John Heinz NWR ¹				Nesting ¹	Federal T&E ²	PA T&E ³	BCR 30 ⁴	PIF 44 ⁵	USFWS North Atlantic LCC Priority List ⁶	USFWS Birds of Conserv. Concern ⁷	Federal Trust Fish	PA SWAP Priority ⁸	North Atlantic Shorebird Plan ⁹	North American Waterbird Plan ¹⁰	Waterfowl Management Plan ¹¹
	Spr	Sum	Fall	Win												
LANDBIRDS (cont)																
Broad-winged Hawk	o	o	c	r				H					MC			
Brown Creeper	c		c	c												
Brown Thrasher	c	c	c	o	Y			H	2				MC			
Canada Warbler	c	r	c					M		X	X		MC			
Cerulean Warbler	r	r	r					M	1B		X		HC			
Chimney Swift	c	c	c					H	2				MC			
Cliff Swallow	o	r	o						5							
Common Nighthawk	c	o	c										MC			
Cooper’s Hawk	o	r	o	o					5							
Dickcissel	r	r	r	r					3				HC			
Eastern Kingbird	c	c	c		Y			H								
Eastern Meadowlark	o	r	o	r									MC			
Eastern Wood Pewee	o	r	o						1B							
Field Sparrow	c	o	c	c	Y			H	2							
Golden Eagle	r		r	r									V			
Golden-winged Warbler	r	r	r					M			X		HC			
Grasshopper Sparrow	r		r					M					MC			
Gray Catbird	c	c	c	o	Y			M	2							
Great Crested Flycatcher	o	r	o		Y			H								
Henslow’s Sparrow	r		r						1B		X		HC			
Kentucky Warbler	r	r	u					H	1B		X		MC			
Loggerhead Shrike	r	r	r	r			PE		5		X		IC			
Long-eared Owl	r		r	r									HC			
Louisiana Waterthrush	r	r	u					H	1B				R			
Marsh Wren	c	c	c	r	Y		CR	H					HC			

Species	Seasons/Abundance at John Heinz NWR ¹				Nesting ¹	Federal T&E ²	PA T&E ³	BCR 30 ⁴	PIF 44 ⁵	USFWS North Atlantic LCC Priority List ⁶	USFWS Birds of Conserv. Concern ⁷	Federal Trust Fish	PA SWAP Priority ⁸	North Atlantic Shorebird Plan ⁹	North American Waterbird Plan ¹⁰	Waterfowl Management Plan ¹¹
	Spr	Sum	Fall	Win												
LANDBIRDS (cont)																
Northern Bobwhite	r	r	r	r				H	2				IC			
Northern Flicker	c	c	c	o	Y			H								
Northern Goshawk	r		r	r									V			
Northern Harrier	c	o	c	c	Y		CA		5				HC			
Northern Oriole	c	o	c	r	Y			H								
Olive-sided Flycatcher	r		u								X		IC			
Osprey	o	o	o				PT		5				V			
Peregrine Falcon	r	r	r	r			PE		5		X		HC			
Pine Siskin	r	r	o	o									V			
Prairie Warbler	c	r	c					HH	1B	X	X		MC			
Prothonotary Warbler	r	r	u					H	1B				HC			
Red Crossbill				r									V			
Red-headed Woodpecker	r	r	r					M	2		X					
Red-shouldered Hawk	o	r	o	o					5				MC			
Rusty Blackbird	c	r	c	o				H			X					
Savannah Sparrow	c	r	c	r	Y				5							
Scarlet Tanager	c	r	c					H	2				R			
Sedge Wren	r	r	r		Y		PE	M	1B		X		IC			
Sharp-shinned Hawk	o	r	o	r									MC			
Short-eared Owl	o		o	o			PE	M	5		X		IC			
Summer Tanager	r	r	r										HC			
Swainson’s Thrush	c	o	c								X		V			
Vesper Sparrow	c	o	o	o					5							
Whip-poor-will	r	r	r					H			X		MC			
White-eyed Vireo	c	c	c		Y				1B							

Species	Seasons/Abundance at John Heinz NWR ¹				Nesting ¹	Federal T&E ²	PA T&E ³	BCR 30 ⁴	PIF 44 ⁵	USFWS North Atlantic LCC Priority List ⁶	USFWS Birds of Conserv. Concern ⁷	Federal Trust Fish	PA SWAP Priority ⁸	North Atlantic Shorebird Plan ⁹	North American Waterbird Plan ¹⁰	Waterfowl Management Plan ¹¹
	Spr	Sum	Fall	Win												
LANDBIRDS (cont)																
Willow Flycatcher	c	c	u		Y								MC			
Winter Wren	o		c	r									MC			
Wood Thrush	c	c	c	r	Y			HH	1B	X	X		R			
Worm-eating Warbler	r	r	u					H	1B		X		R			
Yellow-bellied Flycatcher	r	r	u				PE						V			
Yellow-breasted Chat	c	c	c	r	Y				2				MC			
Yellow-throated Vireo	o	r	o					H	1B				MC			
SHOREBIRDS																
American Woodcock	c	c	c	r	Y			HH		X			MC	X		
Black-bellied Plover	o	r	c	r				H								
Buff-breasted Sandpiper			r					H			X					
Common Snipe	c	r	c	o				M								
Dunlin	o		o	r				H								
Greater Yellowlegs	c	o	c	r				H								
Hudsonian Godwit			o					H			X					
Killdeer	a	a	a	o	Y			M								
Least Sandpiper	o	o	o	r				M								
Lesser Yellowlegs	o	o	0	r				M			X					
Marbled Godwit			r					H			X					
Piping Plover	r		r			E		HH	1A	X				X		
Red Knot	r		r					HH		X	X			X		
Red-necked Phalarope	r		r							X						
Ruddy Turnstone	r	r	r					HH								
Sanderling	r		r					HH		X						
Semipalmated Plover	c	r	c					M								

Species	Seasons/Abundance at John Heinz NWR ¹				Nesting ¹	Federal T&E ²	PA T&E ³	BCR 30 ⁴	PIF 44 ⁵	USFWS North Atlantic LCC Priority List ⁶	USFWS Birds of Conserv. Concern ⁷	Federal Trust Fish	PA SWAP Priority ⁸	North Atlantic Shorebird Plan ⁹	North American Waterbird Plan ¹⁰	Waterfowl Management Plan ¹¹
	Spr	Sum	Fall	Win												
SHOREBIRDS (cont.)																
Semipalmated Sandpiper	c	o	c	r				H		X	X					
Short-billed Dowitcher	o	r	o	r				H			X					
Solitary Sandpiper	c	o	c								X		MC			
Spotted Sandpiper	c	c	c		Y			M								
Upland Sandpiper	r	r	r				PT	M	1B		X		IC			
Western Sandpiper		r	o	r				M								
Whimbrel	r		r					HH		X	X			X		
White-rumped Sandpiper	o	o	o					H								
Willet	r		r					H	3							
Wilson’s Phalarope	r	r	r					H								
MAMMALS																
Marsh rice rat	nc	nc	nc	nc			SX									
Northern river otter	nc	nc	nc	nc			CA						MC			
AMPHIBIANS																
Southern leopard frog	c	c	c	c	Y		PE						V			
REPTILES																
Eastern mud turtle	nc	nc	nc	nc	Y		PX									
Eastern redbelly turtle	u	u	u	u	Y		PT						HC			
FISH																
American eel	p	p	p	p								X	MC			
Alewife	p	p	p	p						X		X				
Blueback Herring	p	p	p	p								X				
Eastern mudminnow	p	p	p	p			CR									
Hickory shad	p	p	p	p			PE					X				
Striped Bass	p	p	p	p						X		X				
Shortnose sturgeon	nc	nc	nc	nc		E	PE			X		X	IC			

Species	Seasons/Abundance at John Heinz NWR ¹				Nesting ¹	Federal T&E ²	PA T&E ³	BCR 30 ⁴	PIF 44 ⁵	USFWS North Atlantic LCC Priority List ⁶	USFWS Birds of Conserv. Concern ⁷	Federal Trust Fish	PA SWAP Priority ⁸	North Atlantic Shorebird Plan ⁹	North American Waterbird Plan ¹⁰	Waterfowl Management Plan ¹¹
	Spr	Sum	Fall	Win												
PLANTS																
Waterhemp Ragweed	p	p	p	p			PR					X	MC			
Field Dodder	p	p	p	p			PT									
Walter's Barnyard-grass	p	p	p	p			PE									
A Eupatorium	p	p	p	p												
Forked Rush	p	p	p	p			PT									
Shrubby Camphor-weed	p	p	p	p						X		X				

Sources

¹ U.S. Fish and Wildlife Service. John Heinz NWR at Tinicum Web site. Available online at <http://www.fws.gov/heinz/index.html>; accessed January 2012.

a—abundant; c—common; u—uncommon; o—occasional; r—rare; nc—not confirmed on refuge, but potential habitat;
p—present (from surveys) but seasonal abundance unknown

² U.S. Fish and Wildlife Service. Endangered Species Program Web site. Available online at http://ecos.fws.gov/tess_public/pub/listedAnimals.jsp; accessed January 2012.

E—Endangered; T—Threatened; R—Rare

³ Pennsylvania Fish and Boat Commission. The Pennsylvania Code, Chapter 75: Endangered Species. Available online at <http://www.pacode.com>; accessed March 2012.

Pennsylvania Game Commission. Threatened and Endangered Species Web site. Available online at <http://www.portal.state.pa.us>; accessed March 2012.

Natural Heritage Program. Pennsylvania Natural Heritage Program Web site. Available online at <http://www.naturalheritage.state.pa.us>; accessed March 2012.

PE—Endangered; PT—Threatened; PR—Rare; PX/SX—Extirpated; CA—Candidate at Risk; CR—Candidate Rare

⁴ U.S. Fish and Wildlife Service. 2008. New England Mid-Atlantic Coast Bird Conservation Region (BCR 30) Implementation Plan. Atlantic Coast Joint Venture, Hadley, MA: Region 5, Fish and Wildlife Service, U.S. Department of the Interior. http://www.acjv.org/BCR_30/BCR30_June_23_2008_final.pdf; accessed January 2012.

HH—Highest Priority; H—High Priority; M—Moderate Priority

⁵ Partners in Flight. April 1999. Partners in Flight: Mid-Atlantic Coastal Plain Bird Conservation Plan (Physiographic Area #44) Version 1.0. Williamsburg, VA.

Prioritization Rankings = 1 (Highest)—5 (Lowest)

⁶ U.S. Fish and Wildlife Service. December 2009. North Atlantic Landscape Conservation Cooperative Development and Operations Plan. U.S. Department of Interior, U.S. Fish and Wildlife Service, Northeast Region. Hadley, MA. 38 pp.

⁷ U.S. Fish and Wildlife Service. 2008. Birds of conservation concern 2008. Division of Migratory Bird Management, Arlington, Virginia. 93 pp. Online version available at <http://www.fws.gov/migratorybirds/NewReportsPublications/SpecialTopics/BCC2008/BCC2008.pdf>; accessed January 2012.

⁸ Pennsylvania Game Commission/Pennsylvania Fish and Boat Commission. Accessed December 2008. State Wildlife Action Plan. Available online at <http://www.portal.state.pa.us/portal/server.pt?open=514&objID=622722&mode=2>; accessed January 2012.
IC—Immediate Concern (Tier 1); HC—High Level Concern (Tier 2); R—Responsibility Species (Tier 3); V—Vulnerable Species (Tier 4); MC—Maintenance Concern (Tier 5)

⁹ Clark, K.E., L.J. Niles, and the North Atlantic Shorebird Habitat Working Group. 2000. U.S. Shorebird Conservation Plan: North Atlantic Regional Shorebird Plan Version 1.0. <http://www.fws.gov/shorebirdplan/RegionalShorebird/downloads/NATLAN4.pdf>; accessed January 2012.

¹⁰ Kushlan, J.A., M.J. Steinkamp, K.C. Parsons, J. Capp, M.A. Cruz, M. Coulter, I. Davidson, L. Dickson, N. Edelson, R. Elliot, R.M. Erwin, S. Hatch, S. Kress, R. Milko, S. Miller, K. Mills, R. Paul, R. Phillips, J.E. Saliva, B. Sydeman, J. Trapp, J. Wheeler, and K. Wohl. 2002. Waterbird Conservation for the Americas: The North American Waterbird Conservation Plan, Version 1. Waterbird Conservation for the Americas. Washington, DC. Online version available at: http://www.waterbirdconservation.org/pdfs/plan_files/complete.pdf; accessed January 2012.

¹¹ Atlantic Coast Joint Venture. February 2007. North American Waterfowl Management Plan: Continental Progress Assessment. Population Trend Data = I—Increasing; D—Decreasing; NT—No Trend

Appendix B

LaVonda Walton/USFWS



Interpretive signs help connect visitors with nature.

Findings of Appropriateness and Compatibility Determinations

Findings of Appropriateness and Compatibility Determinations

Finding of Appropriateness—Dog Walking in Designated Areas	B-1
Compatibility Determination—Dog Walking in Designated Areas	B-3
Finding of Appropriateness—Jogging.	B-9
Compatibility Determination—Jogging	B-11
Finding of Appropriateness—Non-motorized Boating	B-19
Compatibility Determination—Non-motorized Boating	B-21
Finding of Appropriateness—Bicycling.	B-27
Compatibility Determination—Bicycling	B-29
Compatibility Determination—Recreational Fishing	B-35
Compatibility Determination—Wildlife Observation, Photography, Environmental Education, and Interpretation	B-43

FINDING OF APPROPRIATENESS OF A REFUGE USE**Refuge Name:** John Heinz National Wildlife Refuge at Tinicum**Use:** Dog Walking in Designated Areas

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision criteria:	YES	NO
(a) Do we have jurisdiction over the use?	✓	
(b) Does the use comply with applicable laws and regulations (Federal, State, Tribal, and local)?	✓	
(c) Is the use consistent with applicable Executive orders and Department and Service policies?	✓	
(d) Is the use consistent with public safety?	✓	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	✓	
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	✓	
(g) Is the use manageable within available budget and staff?	✓	
(h) Will this be manageable in the future within existing resources?	✓	
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?	✓	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?	✓	

Where we do not have jurisdiction over the use ["no" to (a)], there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ["no" to (b), (c), or (d)] may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes ☒ No ☐.

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate ☐ **Appropriate** ☒

Refuge Manager: 

Date: 7/17/2012

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence:

Refuge Supervisor: 

Date: 7/30/12

A compatibility determination is required before the use may be allowed.

JUSTIFICATION FOR A FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: John Heinz National Wildlife Refuge at Tinicum

Use: Dog Walking in Designated Areas

NARRATIVE:

Dog walking has been authorized on the refuge for many years. We are not aware of any conflicts with other public uses or negative effects on refuge resources from this use. Although dogs can increase disturbance to wildlife, the refuge enforces a 6-foot leash restriction to keep the dog localized and under control at all times with the pedestrian. We believe most dog walkers are local residents, who regularly visit the refuge and understand our policy. Limiting the area for dog walking to access roads and parking lot areas open to public use on the refuge will keep potential disturbance to a minimum and provide a valuable service for the local neighborhood, while increasing understanding and appreciation of both the refuge and Service mission among gateway community residents. Allowing leashed dog walking on access roads and parking areas will not materially interfere with, or detract from, the mission of the National Wildlife Refuge System or the purposes for which the refuge was established.

COMPATIBILITY DETERMINATION

USE:

Dog Walking in Designated Areas

REFUGE NAME:

John Heinz National Wildlife Refuge at Tinicum (John Heinz NWR, refuge)

ESTABLISHING AND ACQUISITION AUTHORITY(IES):

Public Law 92-326 (as amended)

REFUGE PURPOSE(S):

John Heinz NWR (John Heinz NWR, refuge) was established in 1972 under Special Legislation for the following purposes:

- “Preserving, restoring, and developing the natural area known as Tinicum Marsh....a wildlife interpretative center for the purpose of promoting environmental education, and to afford visitors an opportunity for the study of wildlife in its natural habitat.” (86 Stat. 891, dated June 30, 1972).

Additional refuge lands were acquired under the following authorities:

- To be of “particular value in carrying out the national migratory bird management program.” 16 U.S.C. §667b (An Act Authorizing the Transfer of Certain Real Property for Wildlife);
- “[D]evelopment, advancement, management, conservation, and protection of fish and wildlife resources... (16 U.S.C. §742f (a)(4))...for the benefit of the United States Fish and Wildlife Service, in performing its activities and services....” 16 U.S.C. §742f(b)(1) (Fish and Wildlife Act of 1956); and,
- “[F]or use as an inviolate sanctuary, or for any other management purpose, for migratory birds....” 16 U.S.C. §715d (Migratory Bird Conservation Act).

NATIONAL WILDLIFE REFUGE SYSTEM MISSION:

“The mission of the System is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans” (Pub. L. 105–57; 111 Stat. 1252).

DESCRIPTION OF USE:

(a) What is this use? Is it a priority public use?

The use is dog walking. Dog walking is not a priority public use of National Wildlife Refuge System under the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. 668dd-668ee), as amended by the National Wildlife Refuge System Improvement Act of 1997 (Public Law 105-57).

(b) Where will the use be conducted?

Dog walking will be permitted only on refuge public use access roads and parking lot areas and prohibited on woodland foot paths or off trails (map B.1). The refuge access roads are located atop low habitat value dike perimeter trail outlining the 145-acre fresh water impoundment and along the edge of Interstate 95 between the impoundment and the west end of the refuge at Hwy 420. Refuge staff uses these areas as maintenance roads for the impoundment and they double function as pedestrian access routes for foot and bicycle use to view the refuge and facilitate other public use activities. With only a 6-foot leash, dogs will not be able to access any sensitive areas or disturb birds or other species except on the dike, where fewer interactions are likely to occur.

(c) When will the use be conducted?

Dog walking will be allowed throughout the entire year, during the refuge's normal open hours. The refuge is open daily sunrise to sunset.

(d) How will the use be conducted?

Dog walkers will be allowed to walk their dogs only when the dog is attached to a 6-foot (or less) leash and the dog walker is in control of the leash at all times. This leash law and areas open to dog walking will be strictly enforced to minimize wildlife and visitor disturbance. All dog walkers with properly leashed dogs are restricted to the designated refuge access roads and parking areas at all times. Dog owners will be required to pick up after their dogs. The refuge currently provides doggy bags near the main entrance (8601 Lindbergh Blvd.) for visitor convenience but it is the dog walkers' responsibility to bring or obtain such materials.

(e) Why is this use being proposed?

John Heinz NWR is a unique urban environment surrounded by apartments, private homes, and industrial areas where local neighbors have little or no other nearby areas of green space. We currently allow dog walking on the refuge and have not had significant negative impacts from this use. It has been a long time tradition for residents of the local community to use these portions of the refuge for this activity building strong local support and allowing an excellent opportunity to educate dog walkers about the refuge and the National Wildlife Refuge System. Local dog walkers have been historically very good about keeping their pets on leashes and cleaning up after them. Regulatory signs and brochure information helps reinforce these rules as well. Through the final CCP we will permit dog walking on designated refuge access roads and parking lot areas as an important service to residents of the local community.

AVAILABILITY OF RESOURCES:

Except for maintaining and periodically updating existing signs explaining the new regulations, minimal costs will be involved. Monitoring of the site for compliance will continue, but will not require significantly more resources beyond those already necessary to patrol the area for compliance with current regulations relating to dog walking and other activities within these designated public use areas of the refuge. Permitting this use is within the resources available to administer our Visitor Services Program. There is no additional staff or material costs incurred to the refuge. Compliance with the leash law is within the regular duties of the station law enforcement officer. The financial and staff resources necessary to provide and administer this use at its current level and at the level described in the final CCP are now available and we expect them to be available in the future. The annualized cost associated with the administration of pedestrian travel on the refuge is estimated below:

Providing information to the public and administration needs	=	\$1,000
Resource impacts/monitoring	=	\$1,000
Maintenance needs	=	\$2,000
Total	=	\$4,000

Based on existing refuge expenditures for managing visitor use, funding is adequate to ensure compatibility at the current level of use and to administer and manage the subject use.

ANTICIPATED IMPACTS OF THE USE:

Because the refuge access roads and adjacent parking areas follow a dike system with limited habitat value, the potential impacts to wildlife and their habitats are minimal.

The presence of dogs may flush incubating birds from nests (Yalden and Yalden 1990), disrupt breeding displays (Baydack 1986), disrupt foraging activity in shorebirds (Hoopes 1993), and disturb roosting activity in ducks (Keller 1991). Many of these authors indicated that people with dogs on a leash, and loose dogs provoked the most pronounced disturbance reactions from their study animals. The greatest stress reaction results from unanticipated disturbance. Animals show greater flight response to humans moving unpredictably than to humans following a distinct path (Gabrielsen and Smith 1995). Despite thousands of years of domestication, dogs still maintain instincts to hunt and chase. The appropriate stimulus can trigger those instincts. Dogs that are unleashed or not under the control of their owners may disturb or threaten the lives of some wildlife. In effect, off-leash dogs increase the radius of human recreational influence or disturbance beyond what it will be in the absence of a dog.

The role of dogs in wildlife diseases is poorly understood. However, dogs host endo- and ecto-parasites, and can contract diseases from or transmit diseases to wild animals. In addition, dog waste is known to transmit diseases that may threaten the health of some wildlife and other domesticated animals. Domestic dogs potentially can introduce various diseases and transport parasites into wildlife habitats (Sime 1999).

There will be no impacts to the hydrology, plants, or soils due to the restricted nature of this use. The use will be confined to existing roads and no new construction or vegetation clearing is required. Impacts on wildlife will be minimal since the trails are not close enough to wildlife concentration areas and the dogs will be leashed. Short-term disturbance may occur to wildlife directly adjacent to this road. The use will be confined to existing public use areas and no new construction or vegetation clearing is required.

User conflicts are unlikely to occur since the open areas authorized for dog walking are wide and can accommodate a variety of users. Dog waste can create an unsightly environment to other refuge visitors. Although these negative impacts exist, they are kept to a minimum by restricting dog walking to designated areas of the refuge and strictly enforcing the leash and pick up after pet policies. Standard pet waste bags and disposal sites are available on the refuge.

It is anticipated that leashed dog walking on the designated routes will not cause any direct or indirect impacts to federally listed, threatened or endangered species. Bald eagles and peregrine falcons are the only former federally listed, threatened or endangered species known to use the refuge for roosting or feeding. Bald eagles also now nest on the refuge.

PUBLIC REVIEW AND COMMENT:

As part of John Heinz NWR's Comprehensive Conservation Plan process, this compatibility determination was released for a 30-day public review and comment period following the release of the draft Comprehensive Conservation Plan and Environmental Assessment.

DETERMINATION (CHECK ONE BELOW):

☐ Use is not compatible.

☒ Use is compatible, with the following stipulations.

STIPULATIONS NECESSARY TO ENSURE COMPATIBILITY:

- Only leashed dogs will be allowed on the refuge. The leash will be no more than 6 feet long. Dog walkers will be required to maintain control of their animal while on the refuge, thereby reducing the potential and severity of impacts to wildlife and must refrain from entering closed areas.
- Dog walkers must pick up after their dog(s) and remove or properly dispose of pet waste.
- Agency and public awareness will be increased through interpretive or educational materials about responsible pet ownership in the context of wildlife disturbance during all outdoor recreational pursuits. Information will also address the potential role of domestic dogs in disease transmission to wildlife and vice versa in educational materials; information should include endoparasites and ectoparasites.
- Refuge staff and volunteers will monitor uses to ensure compatibility, refine user estimates, and evaluate compliance. Potential conflicts between user groups will also be evaluated.
- If a high number of negative dog-wildlife interactions or dog-human interactions are reported on refuge access roads and parking areas, the refuge will reassess the use.
- If a high number of off-leash incidents are documented, we may consider eliminating dog walking from the refuge altogether.
- Restricting dog walking to the designated access roads and parking areas will reduce the potential disturbance of wildlife.
- Dog walking is restricted to designated refuge access roads and parking areas only (map B.1) and prohibited from all woodland foot trails.

JUSTIFICATION:

We currently allow dog walking on the refuge and have not had significant negative impacts from this use. Although dogs can increase disturbance to wildlife, the refuge enforces a leash law to keep the dog localized with the pedestrian. We believe most dog walkers are local residents, who regularly visit the refuge and understand our policy. Limiting the area for dog walking to public use access roads and parking areas of the refuge will keep potential disturbance to a minimum.

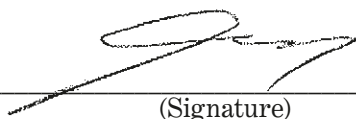
We predict the stipulations (listed above) that we will require of dog walkers will negate or minimize any dog-related wildlife impacts as discussed in the potential impacts section. Dogs will be under the direct control of their owners at all times while on the refuge. This should minimize any potential impacts that could result from the use. We will require all dogs to be on leashes of 6 feet or less, which will prevent dogs from interacting with wildlife in the impoundment areas. The access roads and parking lots are located atop low habitat value dikes entrance areas of compacted soils and/or pavement. With only a 6-foot leash, dogs will not be able to access any sensitive areas or disturb birds or other species except on the dike, where fewer interactions are likely to occur. To date, no negative dog-wildlife interactions have been reported from the sections of the refuge where dogs have been historically allowed.

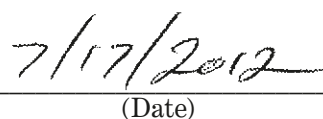
Dog walking will add to the number of people partaking in wildlife observation and interpretation, contributing to refuge purposes and to providing opportunities for some of the priority public uses. As a result of the stipulations imposed (specified above), this use is expected to result in only minimal impacts to other refuge purposes. The impacts will be limited to the low quality habitat atop access roads and parking lots only. The use is not expected to have any impact on other refuge purposes.

Dog walking has been determined to be compatible provided the stipulations necessary to ensure compatibility are implemented, and the use does not exceed thresholds necessary for visitor safety and resource protection. Dog walking in designated areas of the refuge is not expected to materially interfere with or detract from the mission of the National Wildlife Refuge System nor diminish the purposes for which the refuge was established, will not pose significant adverse effects on refuge resources, will not interfere with other public uses of the refuge, nor cause an undue administrative burden.

SIGNATURE:

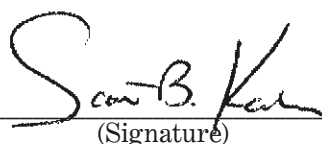
Refuge Manager:

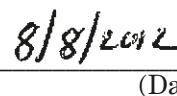

(Signature)


(Date)

CONCURRENCE:

Regional Chief:


(Signature)


(Date)

MANDATORY 10 YEAR RE-EVALUATION DATE:



LITERATURE CITED:

- Baydack, R.K. 1986. Sharp-tailed grouse response to lek disturbance in the Carberry Sand Hills of Manitoba. Colorado State University, Fort Collins, Colorado.
- Gabrielson, G.W., and E.N. Smith. 1995. Physiological responses of wildlife to disturbance. Pages 95-107 in R.L. Knight and K.J. Gutzwiller, ed. Wildlife and Recreationists: coexistence through management and research. Island Press, Washington, D.C. 372pp.
- Hoopes, E.M. 1993. Relationships between human recreation and piping plover foraging ecology and chick survival. Thesis, University of Massachusetts, Amherst, Massachusetts.
- Keller, V. 1991. Effects of human disturbance on eider ducklings *Somateria mollissima* in an estuarine habitat in Scotland. Biological Conservation 58:213-228.
- Sime, C.A. 1999. Domestic Dogs in Wildlife Habitats. Pp. 8.1-8.17 in G. Joslin and H. Youmans, coordinators. Effects of recreation on Rocky Mountain wildlife: A Review for Montana. Committee on Effects of Recreation on Wildlife, Montana Chapter of The Wildlife Society.
- Yalden, P.E., and D. Yalden. 1990. Recreational disturbance of breeding golden plovers (*Pluvialis apricarius*). Biological Conservation 51:243-262.

Dog Walking Trails (leashed dogs only)

John Heinz National Wildlife Refuge

Dog walking is ONLY allowed on Trails marked in Yellow

Legend

- Hiking Only - NO Bikes
- Wheelchair accessible
- Canoe Trail
- Maintenance Facility
- Fishing
- Wildlife Observation
- Parking
- Casino Environmental Education Center
- Area Closed to Visitors
- No Fishing Area
- roadways
- shrub grass wetland
- forest
- grassland
- tidal marsh
- open water
- Pipeline

Trails:

- Impoundment Loop Trail (3.1 mi.)
- 420 Trail (4.0 mi.)
- Restoration Site Trail

Other Features:

- Main Entrance
- Visitor Center
- Canoe Launch
- Impoundment
- Area Closed
- 10 Visitors
- Derby Township
- Falcon Borough
- Norwood Borough
- Warramaker Ave.
- Ridley Park Borough
- Tinicum Township
- Estington

Scale: 0 0.2 0.4 0.8 Miles

North Arrow: N, S, E, W

FINDING OF APPROPRIATENESS OF A REFUGE USE**Refuge Name:** John Heinz National Wildlife Refuge at Tinicum**Use:** Jogging

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision criteria:	YES	NO
(a) Do we have jurisdiction over the use?	✓	
(b) Does the use comply with applicable laws and regulations (Federal, State, Tribal, and local)?	✓	
(c) Is the use consistent with applicable Executive orders and Department and Service policies?	✓	
(d) Is the use consistent with public safety?	✓	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	✓	
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	✓	
(g) Is the use manageable within available budget and staff?	✓	
(h) Will this be manageable in the future within existing resources?	✓	
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?	✓	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?	✓	

Where we do not have jurisdiction over the use ["no" to (a)], there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ["no" to (b), (c), or (d)] may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes ☒ No ☐.

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate ☐ **Appropriate** ☒

Refuge Manager: 

Date: 7/17/2012

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence:

Refuge Supervisor: 

Date: 7/30/12

A compatibility determination is required before the use may be allowed.

JUSTIFICATION FOR A FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: John Heinz National Wildlife Refuge at Tinicum

Use: Jogging

NARRATIVE:

Jogging has been authorized on the refuge for many years. We are not aware of any conflicts with other public uses or negative effects on refuge resources from this use. Because refuge access roads and trails are maintained and open for public use, jogging is a low impact activity on the refuge. Cooke (1980) reported that passerine birds in suburban areas where human activity is ubiquitous, habituate to the activities and are not disturbed as often as birds in rural areas. Burger (1986) found that ducks and shorebirds on the mid-Atlantic coast exhibited sensitivity to joggers. However, Carlson and Godfrey (1989) documented that management strategies such as constructing elevated boardwalks, fencing sensitive areas, and educating visitors reduced human impacts. Because of the existing public use on the refuge and the refuge's location in a highly urbanized environment, disturbances to wildlife are expected to be minimal.

We believe most joggers are local residents, who regularly visit the refuge and understand our rules. Limiting the area for jogging to existing access roads and trails already open to public use on the refuge will keep potential disturbance to a minimum while increasing understanding and appreciation of both the refuge and Service mission among gateway community residents. This use is not expected to materially interfere with or detract from the mission of the National Wildlife Refuge System nor diminish the purposes for which the refuge was established, will not pose significant adverse effects on refuge resources, will not interfere with public use of the refuge, nor cause an undue administrative burden.

COMPATIBILITY DETERMINATION

USE:

Jogging

REFUGE NAME:

John Heinz National Wildlife Refuge at Tinicum (John Heinz NWR, refuge)

ESTABLISHING AND ACQUISITION AUTHORITY(IES):

Public Law 92-326 (as amended)

REFUGE PURPOSE(S):

John Heinz NWR (John Heinz NWR, refuge) was established in 1972 under Special Legislation for the following purposes:

- “Preserving, restoring, and developing the natural area known as Tinicum Marsh....a wildlife interpretative center for the purpose of promoting environmental education, and to afford visitors an opportunity for the study of wildlife in its natural habitat.” (86 Stat. 891, dated June 30, 1972).

Additional refuge lands were acquired under the following authorities:

- To be of “particular value in carrying out the national migratory bird management program.” 16 U.S.C. §667b (An Act Authorizing the Transfer of Certain Real Property for Wildlife);
- “[D]evelopment, advancement, management, conservation, and protection of fish and wildlife resources... (16 U.S.C. §742f (a)(4))...for the benefit of the United States Fish and Wildlife Service, in performing its activities and services....” 16 U.S.C. §742f(b)(1) (Fish and Wildlife Act of 1956); and,
- “[F]or use as an inviolate sanctuary, or for any other management purpose, for migratory birds....” 16 U.S.C. §715d (Migratory Bird Conservation Act).

NATIONAL WILDLIFE REFUGE SYSTEM MISSION:

“The mission of the System is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans” (Pub. L. 105–57; 111 Stat. 1252).

DESCRIPTION OF USE:

(a) What is the use? Is the use a priority public use?

The use is jogging on John Heinz NWR. This is not a priority public use of the National Wildlife Refuge System under the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. 668dd-668ee), as amended by the National Wildlife Refuge System Improvement Act of 1997.

(b) Where will the use be conducted?

Jogging will be permitted on all established roads, foot trails, and parking areas within the refuge which are currently open to public use (see map B.2). There are approximately 10 miles of trails on the refuge.

Refuge roads and trails designated for pedestrian travel are located primarily on already disturbed areas, i.e., old dikes and access roads with compacted soils and fill materials. While direct impact to wildlife and habitat on these trails is very minimal, the roads and trails provide excellent viewing of many of the refuge's wetland and upland areas and were specifically designed to provide access for visitors with little if any disturbance to wildlife. Wildlife species occurring in the vicinity of roads and trails include migratory birds (waterfowl, songbirds, and others), resident mammals, reptiles, and amphibians.

(c) When will the use be conducted?

Designated public use roads and trails will be open to jogging all year, when the refuge is open. The refuge is usually open daily sunrise to sunset, year-round.

(d) How will the use be conducted?

Jogging is limited to designated roads, trails, parking areas, boardwalks and other visitor service facilities within public use areas of the refuge during the open hours of sunrise to sunset. Brochures and maps depicting the roads and trails open for this use are available at the visitor center and on the refuge's Web site. Groups of 15 or more will require a special use permit.

Refuge roads and trails area already maintained for priority public uses to minimize environmental effects such as erosion and sedimentation and to provide safe conditions for travel. Existing potholes that promote off-road detours are routinely filled with gravel. Roads and trails will be monitored annually to determine if they remain compatible. As a step-down plan, the refuge trail plan will include an inventory of all existing roads and trails.

(e) Why is this use being proposed?

Jogging is a historic use of the refuge. While refuge trails are built on top of lower quality habitat of old dikes or access roads, they provide exceptional opportunities to view wetland communities because they offer unrestricted views and are relatively level for easy pedestrian travel. We believe most joggers are local residents, who regularly visit the refuge and understand our rules. Limiting the area for jogging to existing access roads and trails already open to public use on the refuge will keep potential disturbance to a minimum while increasing understanding and appreciation of both the refuge and Service mission among gateway community residents. At current use levels, allowing jogging and priority public uses on refuge roads and trails is unlikely to be a safety risk.

AVAILABILITY OF RESOURCES:

Permitting this use is within the resources available to administer our Visitor Services Program. Staff time associated with administration of this use is minimal since pedestrian travel is permitted only on existing refuge roads and trails which are maintained for a wide range of maintenance, biological, and priority public uses. The annualized cost associated with the administration of pedestrian travel on the refuge is estimated below:

Providing information to the public and administration needs	=	\$1,000
Resource impacts/monitoring	=	\$1,000
Maintenance needs	=	\$2,000
Total	=	\$4,000

Based on existing refuge expenditures for managing visitor use, funding is adequate to ensure compatibility at the current level of use and to administer and manage the subject use.

ANTICIPATED IMPACTS OF THE USE:

Because pedestrian travel will take place on routes which are currently cleared, maintained and improved; soil, hydrologic, and plant impacts will be minimal.

In general, the presence of humans disturbs most wildlife, which typically results in a temporary displacement without long-term effects on individuals or populations. Disturbance varies by wildlife species involved and the type, level, frequency, duration, and the time of year activities occur. Disturbance can cause shifts in habitat use, abandonment of habitat, and increased energy demands on affected wildlife (Knight and Cole 1991). Miller et al. (1998) found bird abundance and nesting activities (including nest success) increased as distance from a recreational trail increased in both grassland and forested habitats. In this study, common species (e.g., American robins) were found near trails and rare species (i.e., Blackburnian warblers) were found farther from trails. In some cases there is a clear link between the extent of disturbance and either the survival or reproductive success of individuals (e.g. Schulz and Stock 1993), but in many cases disturbance acts in a more subtle way, by reducing access to resources such as food supplies or nesting sites (Gill et al. 1996). Bird flight in response to disturbance can lower reproductive success by exposing individuals and nests to predators. For recreation activities that occur simultaneously (hiking, biking, and horseback riding) there will likely be compounding negative impacts to wildlife (Knight and Cole 1991).

Wildlife disturbance may be compounded by seasonal needs. For example, some species, like warblers, could be negatively affected by disturbance associated with bird watching particularly during the breeding season. When visitors approach nests too closely, they often cause the adult bird to flush exposing the eggs to weather conditions or predators (Banks and Bryant 2007, Miller et al. 2001). The extent of that disturbance along the trail also depends on visibility and the density of vegetation. For songbirds, Gutzwiller et al. (1994) found that low levels of human intrusion altered the singing behavior of some species. Disturbance may also affect the reproductive fitness of males by hampering territory defense, mate selection, and other reproductive functions of vocalizations (Arrese 1987). Disturbance, which leads to reduced singing activity, will make males rely more heavily on physical deterrents, which are time- and energy-consuming in defending territories (Ewald and Carpenter 1978).

As discussed throughout the refuge's draft Comprehensive Conservation Plan, the refuge is located in a highly urban environment, with substantial baseline disturbance associated with the international airport, I-95, several State routes, and numerous houses, businesses, community buildings, and associated human activity. By limiting the presence of humans to refuge trails and infrastructure, refuge visitors are not expected to add significantly to existing disturbance levels of wildlife in upland habitats. Overall, the direct disturbance from public use is expected to have minimal or no adverse effects on wildlife. We will evaluate the sites and programs periodically to assess whether they are meeting the objectives, and to prevent site degradation. If the use causes evident and unacceptable adverse impacts, the refuge will rotate the activities to secondary sites, or curtail or discontinue them.

Bennett and Zuelke (1999) summarize several studies indicating recreation activities will have at least temporary effects on the behavior and movement of birds using shallow water habitats adjacent to trails and roads through wildlife refuges (Burger 1981, 1986; Klein 1993; Burger et al. 1995; Klein et al. 1995; Rodgers and Smith 1997; Burger and Gochfeld 1998). We will take all necessary measures to mitigate those effects, particularly where group educational activities are involved. We will evaluate the sites and programs periodically to assess whether they are meeting the objectives, and to prevent site degradation. If the use causes evident and unacceptable adverse impacts, the refuge will rotate the activities to secondary sites, or curtail or discontinue them.

As discussed previously, it is important to note that the refuge exists within a highly altered area with substantial baseline levels of disturbance associated with interstate traffic, airport activities, adjacent neighborhoods, and roads. Overall, the effects from public use are expected to have minimal adverse effects on birds utilizing open water and wetland habitats. There are few visitor facilities (e.g., trails) in these habitats due to the presence of open water and saturated soils; therefore, they are relatively inaccessible to the public. The size and dense vegetation supported by freshwater tidal marsh and portions of open water should provide adequate buffers to protect wetland bird species like American bittern against human disturbance (Gibbs and Melvin 1992).

There are no known federally listed species on the refuge; therefore, jogging on the designated access roads and trails will not cause significant impacts to threatened or endangered species. The use will be confined to existing roads and no new construction or vegetation clearing is required. Bald eagles and peregrine falcons are the only former federally listed, threatened or endangered species known to use the refuge for roosting or feeding. Both species have been delisted under the Federal Endangered Species Act. Bald eagles now nest on the refuge and are still protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668e). To ensure refuge activities and visitors do not disturb nesting bald eagles, we comply with the Service's National Bald Eagle Guidelines (USFWS 2007).

Some impacts such as littering, vegetation disturbance, and wildlife disturbance can be anticipated, but this is not anticipated to be significant. This is an historic use of the refuge, and we are not aware of any conflicts with other public uses or negative effects on refuge resources from this use. Therefore, the use of refuge roads and trails for jogging will not adversely impact refuge purposes and objectives. Public trash receptacles are provided. Problems associated with littering can be countered through an effective law enforcement program and through public education. The roads are maintained for refuge purposes and there should be no consequences from use by jogging. Maintenance of existing interpretative trails will require only minimum attention.

Disturbance of wildlife can be minimized by seasonal or permanent closure of areas if needed to minimize effects of jogging. Interpretive displays and environmental educational programs will be initiated to provide information to visitors of such disturbance issues.

PUBLIC REVIEW AND COMMENT:

As part of John Heinz NWR's Comprehensive Conservation Plan process, this compatibility determination was released for a 30-day public review and comment period following the release of the draft Comprehensive Conservation Plan and Environmental Assessment.

DETERMINATION (CHECK ONE BELOW):

- ☐ Use is not compatible.
- ☒ Use is compatible, with the following stipulations.

STIPULATIONS NECESSARY TO ENSURE COMPATIBILITY:

- Jogging is permitted only on existing refuge roads and trails within areas designated open to the public.
- Signs necessary for visitor information, safety, and traffic control are maintained.
- Jogging is allowed year-round, between sunrise and sunset.
- Routine law enforcement patrols will enforce refuge regulations regarding jogging off trail and entrance into closed areas to insure protection of wildlife and habitat.
- Groups of 15 or more joggers will require a special use permit.

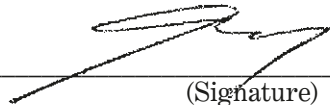
JUSTIFICATION:

This use has been determined to be compatible provided the stipulations necessary to ensure compatibility are implemented, and the use does not exceed thresholds necessary for visitor safety and resource protection. This use is not expected to materially interfere with or detract from the mission of the National Wildlife Refuge System nor diminish the purposes for which the refuge was established, will not pose significant adverse effects on refuge resources, will not interfere with public use of the refuge, nor cause an undue administrative burden.

Jogging has been determined to be compatible provided the stipulations necessary to ensure compatibility are implemented, and the use does not exceed thresholds necessary for visitor safety and resource protection.

SIGNATURE:

Refuge Manager: _____

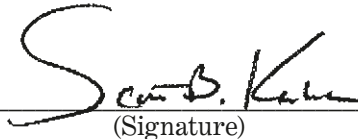


(Signature)

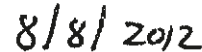


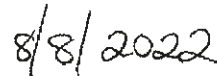
(Date)**CONCURRENCE:**

Regional Chief: _____



(Signature)



(Date)**MANDATORY 10 YEAR RE-EVALUATION DATE:**

LITERATURE CITED:

Arrese, P. 1987. Age, intrusion pressure and defense against floaters by territorial male Song Sparrows. *Animal Behavior* 35:773-784.

Bennett, K., and E. Zuelke. 1999. The Effects of Recreation on Birds: A Literature Review. Unpublished report. Submitted to: DE Division of Parks and Recreation, DNREC.

Burger, J. 1981. Effect of human activity on birds at a coastal bay. *Biological Conservation* 21:231-241.

Burger, J. 1986. The effect of human activity on shorebirds in two coastal bays in northeastern United States. *Environmental Conservation* 13:123-130. Ducks and shorebirds on the mid-Atlantic coast have exhibited sensitivity to joggers.

Burger, J., and M. Gochfeld. 1981. Discrimination of the threat of direct versus tangential approach to the nest by incubating herring and great black-backed gulls. *Journal of Comparative Physiological Psychology* 95:676-684.

Burger, J., and M. Gochfeld. 1998. Effects of Ecotourists on Birds at Loxahatchee Natural Wildlife Refuge. *Environmental Conservation* 25: 13-21.

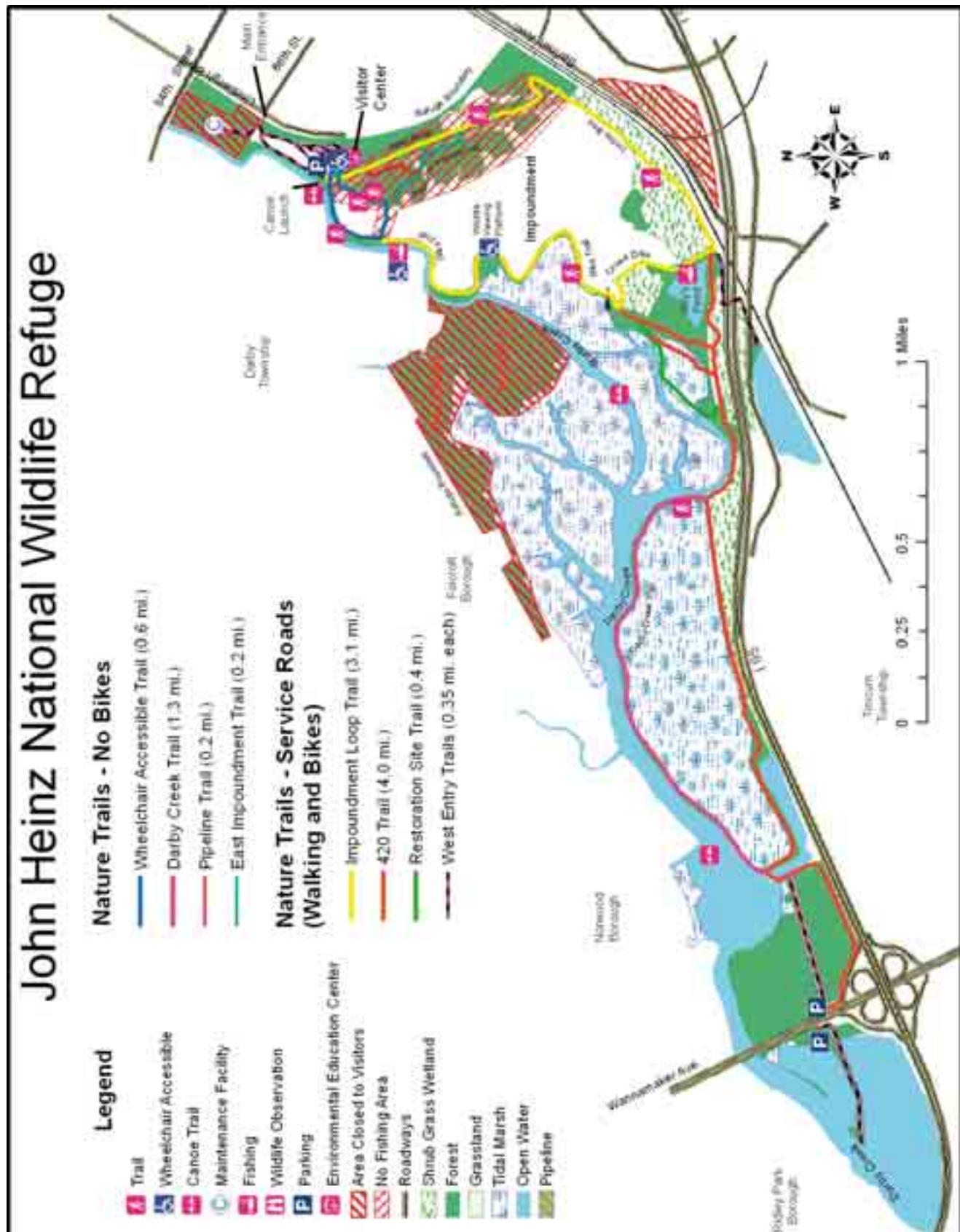
Burger, J., M. Gochfeld, and L.J. Niles. 1995. Ecotourism and birds in coastal New Jersey: Contrasting responses of birds, tourists, and managers. *Environmental Conservation* 22:56-65.

Carlson, L.H., and P.J. Godfrey, 1989. Human impact management in a coastal recreation and natural area. *Biological Conservation* 49(2): 141-156.

Cooke, A.S. 1980. Observations on how close certain passerine species will tolerate an approaching human in rural and suburban areas. *Biological Conservation* 18:85-88.

- Ewald P.W., and F.L. Carpenter. 1978. Territorial responses to energy manipulations in the Anna hummingbird. *Oecologia* 31: 277-292.
- Gibbs, J.P., and S. Melvin. 1992. American Bittern. Pp 51-88 in K.J. Schneider and D.M. Pence (eds.) *Migratory Nongame Birds of Management Concern in the Northeast*. 1992 U.S. Fish and Wildlife Service, Newton Corner, MA. 400p.
- U.S. Fish and Wildlife Service (USFWS). 2007. National Bald Eagle Management Guidelines May 2007. Accessed online May 2011 <<http://www.fws.gov/midwest/eagle/guidelines/index.html>>.

Map B.2. Visitor facilities at John Heinz NWR



FINDING OF APPROPRIATENESS OF A REFUGE USE**Refuge Name:** John Heinz National Wildlife Refuge at Tinicum**Use:** Non-motorized Boating

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision criteria:	YES	NO
(a) Do we have jurisdiction over the use?	✓	
(b) Does the use comply with applicable laws and regulations (Federal, State, Tribal, and local)?	✓	
(c) Is the use consistent with applicable Executive orders and Department and Service policies?	✓	
(d) Is the use consistent with public safety?	✓	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	✓	
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	✓	
(g) Is the use manageable within available budget and staff?	✓	
(h) Will this be manageable in the future within existing resources?	✓	
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?	✓	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?	✓	

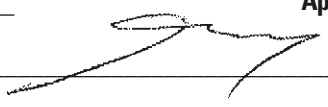
Where we do not have jurisdiction over the use ["no" to (a)], there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ["no" to (b), (c), or (d)] may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes ☒ No ☐.

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate ☐ **Appropriate** ☒

Refuge Manager: 

Date: 7/17/2012

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence:

Refuge Supervisor: 

Date: 7/30/12

A compatibility determination is required before the use may be allowed.

JUSTIFICATION FOR A FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: John Heinz National Wildlife Refuge at Tinicum

Use: Non-motorized Boating

NARRATIVE:

The use of non-motorized watercraft on Darby Creek and associated tidal marsh channels and lagoons of John Heinz National Wildlife Refuge at Tinicum (refuge) will not materially interfere with or detract from the mission of the National Wildlife Refuge System or the purposes for which the refuge was established. Often refuge visitors using non-motorized watercraft are also engaged in priority public uses such as fishing, wildlife observation and photography, and interpretation.

COMPATIBILITY DETERMINATION

USE:

Non-motorized Boating

REFUGE NAME:

John Heinz National Wildlife Refuge at Tinicum (John Heinz NWR, refuge)

ESTABLISHING AND ACQUISITION AUTHORITY(IES):

Public Law 92-326 (as amended)

REFUGE PURPOSE(S):

John Heinz NWR (John Heinz NWR, refuge) was established in 1972 under Special Legislation for the following purposes:

- “Preserving, restoring, and developing the natural area known as Tinicum Marsh....a wildlife interpretative center for the purpose of promoting environmental education, and to afford visitors an opportunity for the study of wildlife in its natural habitat.” (86 Stat. 891, dated June 30, 1972).

Additional refuge lands were acquired under the following authorities:

- To be of “particular value in carrying out the national migratory bird management program.” 16 U.S.C. §667b (An Act Authorizing the Transfer of Certain Real Property for Wildlife);
- “[D]evelopment, advancement, management, conservation, and protection of fish and wildlife resources... (16 U.S.C. §742f (a)(4))...for the benefit of the United States Fish and Wildlife Service, in performing its activities and services....” 16 U.S.C. §742f(b)(1) (Fish and Wildlife Act of 1956); and,
- “[F]or use as an inviolate sanctuary, or for any other management purpose, for migratory birds....” 16 U.S.C. §715d (Migratory Bird Conservation Act).

NATIONAL WILDLIFE REFUGE SYSTEM MISSION:

“The mission of the System is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans” (Pub. L. 105–57; 111 Stat. 1252).

DESCRIPTION OF USE:

(a) What is this use? Is it a priority public use?

The use is non-motorized boating (canoes and kayaks) on John Heinz NWR including maintenance of a canoe trail on the tidal waters of Darby Creek and Tinicum Marsh and the tidal lagoons within the boundaries of the refuge. Non-motorized boating is not a priority public use of the National Wildlife Refuge System under the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. 668dd-668ee), as amended by the National Wildlife Refuge System Improvement Act of 1997. However, many boaters engage in viewing, photographing, or interpreting wildlife, which are priority public uses.

(b) Where will the use be conducted?

Non-motorized boating will be allowed in tidal waters of the refuge including the main channels of the Tinicum Marsh, and lagoons at the west end of the refuge adjacent to Highway 420 (map B.3).

(c) When will the use be conducted?

Non-motorized boating will be permitted when the refuge is open to visitors, usually daily, year-round, from sunrise to sunset.

(d) How will the use be conducted?

Non-motorized boaters enter the refuge at the main entrance on Lindbergh Boulevard and launch at the established canoe launch dock adjacent to the lower parking lot. All boaters will be required to operate their craft and possess all safety equipment in accordance with Pennsylvania State and U.S. Coast Guard regulations. As these areas are shallow and tidal, non-motorized boaters are encouraged through the refuge brochures, Web page, and visitor center information to do their canoeing or kayaking within a 2-hour window on either side of peak high tides for best access. Tide charts are distributed at the refuge visitor center for visitor convenience.

(e) Why is this use being proposed?

Interpretation and wildlife oriented recreation are primary purposes for which the refuge was established. Canoeing and kayaking are traditional means of outdoor recreation which is enhanced by the opportunity to view wildlife. Maintenance of a canoe trail and providing visitors with a canoe trail brochure enables the refuge to interpret refuge specific issues and the goals of the Fish and Wildlife Service.

Continued implementation of the refuge recreational boating program will help the Service meet the goal of the National Wildlife Refuge System "... to provide refuge visitors with high quality, safe, wholesome, and enjoyable recreation experiences oriented toward wildlife...."

AVAILABILITY OF RESOURCES:

We estimate the annual cost of non-motorized boating to be minimal as refuge staff will respond to public inquiries about the program, perform law enforcement patrols, and assist partners with the maintenance of the canoe access site as part of other duties. Refuge staff will continue to receive assistance from the Pennsylvania Fish and Boat Commission and Pennsylvania Department of Environmental Protection who have jurisdiction over navigable portions of these waterways.

We provide a small dock and canoe/kayak launching facility on Darby Creek adjacent to the main visitor center parking lot. There are also nearby off refuge improved launches at commercial marinas further downstream on Darby Creek and Delaware River. We charge no fees for using the refuge canoe launch access area. The annualized cost associated with the administration of non-motorized boating on the refuge is estimated below:

Providing information to the public and administration needs	=	\$3,000
Resource impacts/monitoring	=	\$2,000
Maintenance needs	=	\$1,000
Total	=	\$6,000

Based on existing refuge expenditures for managing visitor use, funding is adequate to ensure compatibility at the current level of use and to administer and manage the subject use.

ANTICIPATED IMPACTS OF THE USE:

Non-motorized boating can affect refuge resources in a number of ways. Studies show that canoes and rowboats disturb wildlife (Bouffard 1982; Kaiser and Fritzell 1984; Knight 1984; Kahl 1991). They may affect waterfowl broods, wintering waterfowl, shorebirds, raptors, and long-legged waders, but their low speed and their use primarily during the warmer months will mitigate those impacts, especially on wintering waterfowl and raptors. The size and dense vegetation supported by freshwater tidal marsh and portions of open water should provide adequate buffers to protect wetland bird species, like American bittern, against human disturbance (Gibbs and Melvin 1992). Boaters also may try to access closed portions of the refuge, causing additional disturbance of wildlife. Due to the shallowness of refuge waters, which can only be physically floated during high tide windows of non-ice seasons, it is anticipated that this use will most likely remain very limited in scope.

The impacts of non-motorized boating on wildlife include temporary disturbances to species using habitat on Darby Creek and adjacent portions of Tinicum Marsh. These disturbances are likely to be short term and infrequent based on current levels of use.

There are no anticipated impacts on cultural resources.

Non-motorized boating use of the refuge will not cause significant impacts to threatened or endangered species. The use will be confined to Darby Creek, the main channels of the Tinicum Marsh, and lagoons at the west end of the refuge adjacent to Hwy 420. No new construction or vegetation clearing is required.

Problems associated with littering can be countered through an effective law enforcement program and through public education.

Darby Creek itself is considered to be a navigable waterway. As such, we do not have jurisdiction boating in this creek.

PUBLIC REVIEW AND COMMENT:

As part of John Heinz NWR's Comprehensive Conservation Plan process, this compatibility determination was released for a 30-day public review and comment period following the release of the draft Comprehensive Conservation Plan and Environmental Assessment.

DETERMINATION (CHECK ONE BELOW):

- ☐ Use is not compatible.
- ☒ Use is compatible, with the following stipulations.

STIPULATIONS NECESSARY TO ENSURE COMPATIBILITY:

- Boaters must comply with all Pennsylvania State and U.S. Coast Guard requirements. Law enforcement efforts on the refuge will ensure compliance with State laws and refuge-specific regulations.
- Parts of the refuge may be closed by management as needed to provide wildlife sanctuary or prevent habitat damage.
- No boats are permitted on the nontidal waters and ponds of the refuge. Boat traffic in the large lagoon is restricted to "Slow No Wake" speed.

- Boaters must restrict their activity to daylight hours only.
- Boaters must report all accidents and injuries to refuge personnel as soon as possible, but before leaving the refuge.
- For other than emergency purposes, boaters are prohibited from landing or launching on refuge lands other than at the canoe launch by the visitor center parking lot.

JUSTIFICATION:

The use of non-motorized watercraft on the Darby Creek and associated tidal marsh channels and lagoons on John Heinz NWR is unlikely to interfere with the primary purposes for which the refuge was established. Refuge visitors use non-motorized watercraft to participate in such priority public uses as fishing, wildlife observation, photography and interpretation. Non-motorized boating on the refuge has been determined to be compatible provided the stipulations necessary to ensure compatibility are implemented, and the use does not exceed thresholds necessary for visitor safety and resource protection. Non-motorized boating is not expected to materially interfere with or detract from the mission of the National Wildlife Refuge System nor diminish the purposes for which the refuge was established, will not pose significant adverse effects on refuge resources, will not interfere with other public uses of the refuge, nor cause an undue administrative burden.

SIGNATURE:

Refuge Manager: _____

(Signature)

7/17/2012

(Date)

CONCURRENCE:

Regional Chief: _____

(Signature)

8/8/2012

(Date)

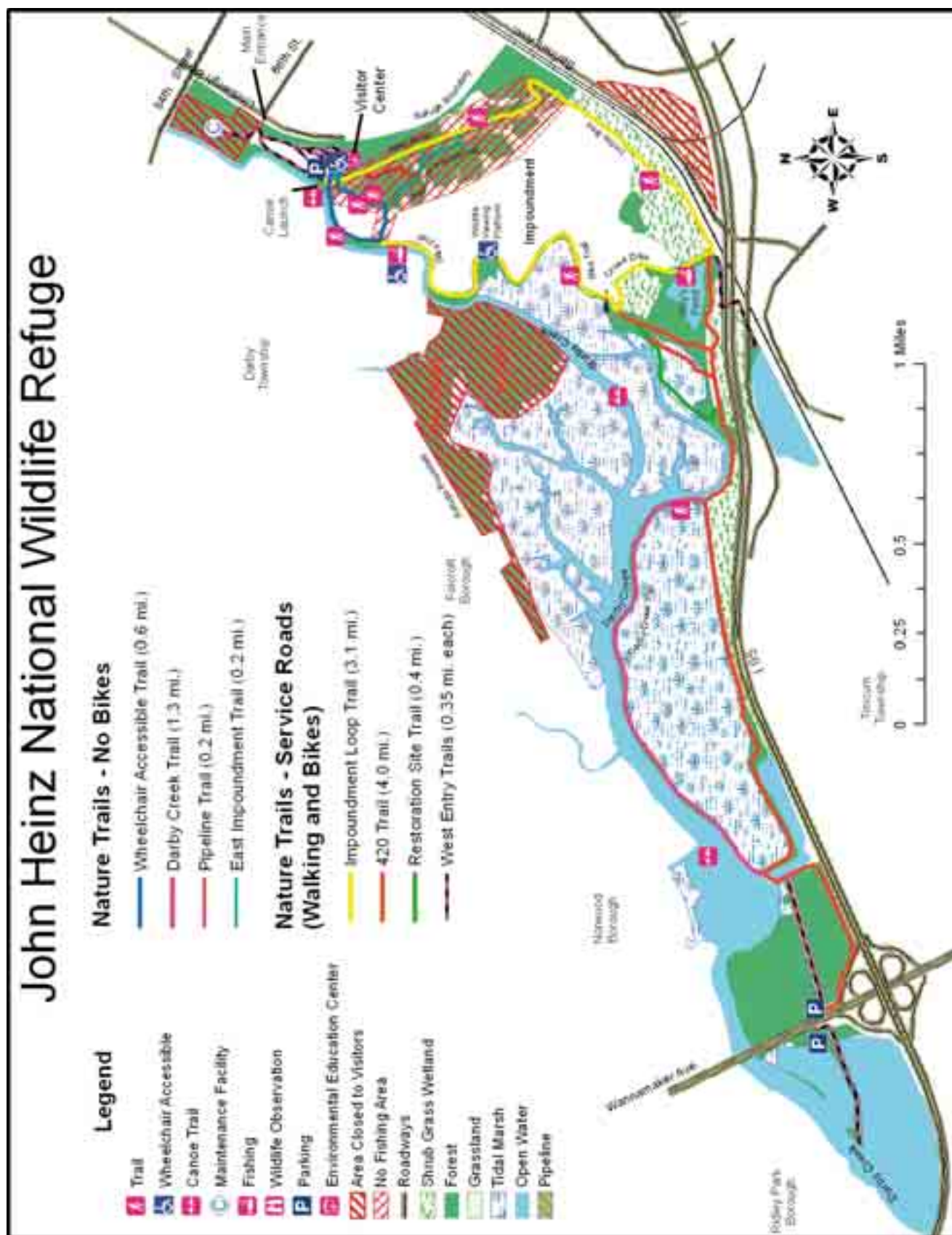
MANDATORY 10 YEAR RE-EVALUATION DATE:

8/8/2022

LITERATURE CITED:

- Bouffard S.H. 1982. Wildlife values versus human recreation: Ruby Lake National Wildlife Refuge. Trans. North American Wildlife and Natural Resources Conference 47:553-558.
- Kahl, R. 1991. Boating disturbance of canvasbacks during migration at Lake Poygan, Wisconsin. Wildlife Society Bulletin 19:243-248.
- Kaiser, M.S., and E.K. Kaiser 1984. Effects of river recreationists on green-backed heron behavior. J. Wildlife Management 48:561-567.
- Knight, R.L. 1984. Responses of wintering bald eagles to boating activity. J. Wildlife Management. 48:999-1004.
- Gibbs, J.P., and S. Melvin. 1992. American Bittern. Pp 51-88 in K.J. Schneider and D.M. Pence (eds.) Migratory Nongame Birds of Management Concern in the Northeast. 1992 U.S. Fish and Wildlife Service, Newton Corner, MA. 400p.

Map B.3. Visitor Facilities at John Heinz NWR.



FINDING OF APPROPRIATENESS OF A REFUGE USE**Refuge Name:** John Heinz National Wildlife Refuge at Tinicum**Use:** Bicycling

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision criteria:	YES	NO
(a) Do we have jurisdiction over the use?	✓	
(b) Does the use comply with applicable laws and regulations (Federal, State, Tribal, and local)?	✓	
(c) Is the use consistent with applicable Executive orders and Department and Service policies?	✓	
(d) Is the use consistent with public safety?	✓	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	✓	
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	✓	
(g) Is the use manageable within available budget and staff?	✓	
(h) Will this be manageable in the future within existing resources?	✓	
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?	✓	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?	✓	

Where we do not have jurisdiction over the use ["no" to (a)], there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ["no" to (b), (c), or (d)] may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes ☒ No ☐.

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate ☐ **Appropriate** ☒

Refuge Manager: 

Date: 7/17/2012

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence:

Refuge Supervisor: 

Date: 7/30/12

A compatibility determination is required before the use may be allowed.

JUSTIFICATION FOR A FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: John Heinz National Wildlife Refuge at Tinicum

Use: Bicycling

NARRATIVE:

Bicycling is an historical recreational use in John Heinz NWR that occurred long before the refuge was created, and it has occurred on the refuge since its establishment.

Bicycle travel is limited to approximately 9 miles of designated access roads and parking areas only, where road width can accommodate the safe passage of bicyclists and other users. Designated roads also have sufficient viewing distance for bicyclists to detect the approach of other users and maneuver to accommodate them. Because of these accommodations, bicycling occurs concurrently and without conflict with other public uses including priority public uses.

Bicycle travel is an ecologically friendly means of green transportation in line with the conservation mission of the Service. Bicycle travel to and through the refuge (in designated areas) is also consistent with local trail and access partnerships including the Philadelphia Planning Department and East Coast Greenways Coalition, connections to city green space corridors, directional signage, community outreach, and educational programs aimed at reconnecting citizens to the outdoors and nature. Both the refuge and the above partner organizations emphasize that bicycles are encouraged as a citywide green transportation initiative to get to the refuge, where visitors are then also encouraged to park their bicycles and walk on refuge trails.

In addition, because bicycling provides easier and quicker access for many visitors who may not otherwise visit the refuge's habitats and other resources, bicycling can contribute to the public's understanding and appreciation of the refuge's natural and cultural resources. Refuge personnel and volunteers have observed bicyclists with binoculars, cameras, and fishing poles showing that they are used to help facilitate priority public uses of the National Wildlife Refuge System.

This use has been determined to be compatible, as stipulated in the associated compatibility determination. This use is not expected to materially interfere with or detract from the mission of the National Wildlife Refuge System nor diminish the purposes for which the refuge was established, will not pose significant adverse effects on refuge resources, will not interfere with public use of the refuge, nor cause an undue administrative burden.

COMPATIBILITY DETERMINATION

USE:

Bicycling

REFUGE NAME:

John Heinz National Wildlife Refuge at Tinicum (John Heinz NWR, refuge)

ESTABLISHING AND ACQUISITION AUTHORITY(IES):

Public Law 92-326 (as amended)

REFUGE PURPOSE(S):

John Heinz NWR (John Heinz NWR, refuge) was established in 1972 under Special Legislation for the following purposes:

- “Preserving, restoring, and developing the natural area known as Tinicum Marsh....a wildlife interpretative center for the purpose of promoting environmental education, and to afford visitors an opportunity for the study of wildlife in its natural habitat.” (86 Stat. 891, dated June 30, 1972).

Additional refuge lands were acquired under the following authorities:

- To be of “particular value in carrying out the national migratory bird management program.” 16 U.S.C. §667b (An Act Authorizing the Transfer of Certain Real Property for Wildlife);
- “[D]evelopment, advancement, management, conservation, and protection of fish and wildlife resources... (16 U.S.C. §742f (a)(4))...for the benefit of the United States Fish and Wildlife Service, in performing its activities and services....” 16 U.S.C. §742f(b)(1) (Fish and Wildlife Act of 1956); and,
- “[F]or use as an inviolate sanctuary, or for any other management purpose, for migratory birds....” 16 U.S.C. §715d (Migratory Bird Conservation Act).

NATIONAL WILDLIFE REFUGE SYSTEM MISSION:

“The mission of the System is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans” (Pub. L. 105–57; 111 Stat. 1252).

DESCRIPTION OF USE:

(a) What is the use? Is the use a priority public use?

The use is bicycling on John Heinz National Wildlife Refuge (NWR) at Tinicum (refuge). Priority public uses of the National Wildlife Refuge System (Refuge System) are hunting, fishing, wildlife observation and photography, environmental education, and interpretation. Bicycling is not a priority public use of the National Wildlife Refuge System under the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. 668dd-668ee), as amended by the National Wildlife Refuge System Improvement Act of 1997. However, many bicyclists engage in viewing, photographing, or interpreting wildlife, which are priority public uses.

(b) Where will the use be conducted?

Bicycling will be permitted on paved and gravel roads and parking lots within the refuge which are currently open to public use. This is limited to the following road and areas:

- Dike Road
- Haul Road
- Trolley Bed
- Darby Creek Trail (access road)
- PENNDOT Access Road
- Refuge Entrance Roads and Parking Areas

These roads total about 9 miles. Roads open for bicycling are shown in map B.4. Refuge roads designated for bicycling are located on the upland areas adjacent to many of the refuge's wetland areas and were specifically designed to provide access.

(c) When will the use be conducted?

Designated roads will be open to bicycling all year. The refuge is open daily sunrise to sunset.

(d) How will the use be conducted?

Bicycling is currently permitted on the refuge. Bicyclists can enter the refuge at public entry points or transport bicycles by vehicle and park at designated parking sites. Visitors accessing the refuge on bicycles are then encouraged to park the bicycles and walk on trails to participate in priority public uses like environmental interpretation and wildlife observation. The use mainly occurs in groups with an average group size of two to four riders. Bicyclists may gather in larger groups for seasonal events like the viewing of fall colors. Formal groups of 10 or more will need special use permits (SUP) and bicycle races are prohibited on the refuge.

Bicycle travel is limited to designated access roads with paved or gravel surfaces and will not be allowed on woodland foot trails or boardwalks. Designated roads have sufficient viewing distance for bicyclists to detect the approach of other users and maneuver to accommodate them.

Safety and information signs are located at refuge entry points and at appropriate sites on designated bicycling trails and roads. Brochures depicting the roads open for this use are available at the refuge visitor center and on the refuge's Web site. Bicycle racks may be added.

(e) Why is this use being proposed?

Bicycling is an historic use of the refuge and there is a high demand for bicycling opportunities locally. In addition, it is the objective of the refuge to facilitate bicycles as a green transportation method for visitors to reach the refuge. Ongoing partnerships with the with Pennsylvania Clean Air Council, East Coast Greenway Coalition, and other partners will help promote and facilitate green transportation and public access to the refuge.

Lastly, because bicycling provides easier and quicker access for many visitors who may not otherwise visit the refuge's habitats and other resources, bicycling can contribute to the public's understanding and appreciation of the refuge's natural and cultural resources, to goals and objectives presented in the John Heinz NWR Comprehensive Conservation Plan, and participation in priority public uses. Refuge personnel and volunteers have observed bicyclists with binoculars, cameras, and fishing poles showing that bicycling is used to help facilitate participation in priority public uses of the Refuge System on the refuge.

AVAILABILITY OF RESOURCES:

Permitting this use is within the resources available to administer our Visitor Services Program. Staff time associated with administration of this use is relatively minimal since bicycling is permitted only on existing refuge roads which are maintained for a wide range of maintenance, biological, and public uses. The most significant cost associated with this public use is associated with enforcing regulations, placing and updating signs, and maintenance of refuge facilities. The annualized cost associated with the administration of bicycling travel on the refuge is estimated below:

Providing information to the public and administration needs	=	\$3,000
Resource impacts/monitoring	=	\$1,000
Maintenance needs	=	\$2,000
Total	=	\$6,000

Based on existing refuge expenditures for managing visitor use, funding is adequate to ensure compatibility at the current level of use and to administer and manage the subject use.

ANTICIPATED IMPACTS OF THE USE:

The presence of people bicycling on refuge roads can lead to displacement of animals from the road, although disturbance usually is a negligible influence on large mammal distributions and movements (Boyle and Samson 1985, Purdy et al. 1987). The effects on other forms of wildlife appear to be short term with the exception of breeding bird communities. A study by Miller et al. (1998) indicates that species composition and nest predation was altered adjacent to trails in both forested and grassland habitats. It appears that species composition changes are due to the presence of humans and not the trail or roadway itself. On the other hand, nest predation does appear to be a function of the trail which allows access to mammalian nest predators. Several studies showed that in areas where human activity was common and frequent, birds were less disturbed than those in areas where humans were uncommon (Miller et al. 2001). The refuge will continue its proven management strategies of educating trail users regarding how their activities affect wildlife and how to modify their use to minimize impacts on wildlife (Klein 1993, Miller et al. 1998).

The use of trails and gravel roads could lead to soil compaction, exposure of tree roots, and the modification of plant species 3 to 6 feet on either side of the trail which is a function of soil compaction, invasive species, and direct trampling of plants (Kuss 1986). The refuge will continue its road maintenance and erosion control, and user education to protect plant species and habitats along trails and roadways. Use of the access roads could pose a threat to endangered or threatened species if such were found utilizing habitat near the road location. In this case, the road use will be monitored and evaluated for such threats and management action will be taken to ensure habitat protection. There are no federally listed species along designated bicycle trails at this time. Potential conflict with priority public uses will be minimized by using information/orientation signs, other media, and personal communication with visitors to inform the various users about current public uses. At current levels of use and restricted to designated roads with hardened and modified surfaces, bicycling will cause minimal surface disturbance and the sharing of designated roads with other users is unlikely to be a safety risk.

The refuge believes that with proper management bicycling will not result in any short-term or long-term impacts that will adversely affect the purpose of the refuge or the mission of the National Wildlife Refuge System.

Roads will be monitored annually to determine if bicycling will remain a compatible use. Bicycling routes and/or other restrictions may be modified if needed with development of a refuge trail plan as a step-down plan to follow the refuge's Comprehensive Conservation Plan. In the interim, the refuge is conducting an inventory of all existing roads and trails.

Opening the Darby Creek Trail to bicycling will not result in additional impacts on wildlife. Access to this section of trail is difficult due to the distance from the visitor center. Opening Darby Creek Trail will improve wildlife observation opportunities. Conflicts with other users are also expected to be negligible as many visitors tend to stay closer to the Visitor Center Trail or route 420 entrances. The Darby Creek Trail has been improved in recent years (width increased and substrate modified) which allows multiple user groups to use the trail without conflict.

PUBLIC REVIEW AND COMMENT:

As part of John Heinz NWR's Comprehensive Conservation Plan process, this compatibility determination was released for a 30-day public review and comment period following the release of the draft Comprehensive Conservation Plan and Environmental Assessment.

DETERMINATION (CHECK ONE BELOW):

- ☐ Use is not compatible.
- ☒ Use is compatible, with the following stipulations.

STIPULATIONS NECESSARY TO ENSURE COMPATIBILITY:

- Bicycling is permitted only on existing paved and gravel roads and parking lots within areas designated as open to bicycling.
- Parts of the refuge may be closed by management as needed to provide wildlife sanctuary and prevent damage to habitat.
- Bicycling is not permitted on foot trails or boardwalks.
- Signs necessary for visitor information, safety, and traffic control are maintained.
- Bicycling is allowed between sunrise and sunset.
- Routine law enforcement patrols will enforce refuge regulations on bicycling.
- Groups of 10 or more bicyclists will require a special use permit.
- Bicycle racing and races are prohibited.

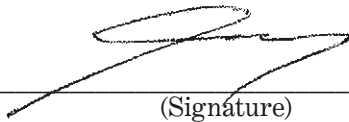
- East Coast Greenway Bicycle Trail overlay will be clearly marked and limited to Dike Road to I-95 and along I-95 corridor to the west entrance of Hwy 420. Partnership publications will clearly define open areas to bicycles and the above refuge specific stipulations.
- Bicycle racks may be added at east and west refuge parking lots as well as appropriate trail heads to foot trails if needed in future.

JUSTIFICATION:

This use has been determined to be compatible provided the stipulations necessary to ensure compatibility are implemented for visitor safety and resource protection. This use is not expected to materially interfere with or detract from the mission of the National Wildlife Refuge System nor diminish the purposes for which the refuge was established, will not pose significant adverse effects on refuge resources, will not interfere with public use of the refuge, nor cause an undue administrative burden.

SIGNATURE:

Refuge Manager:

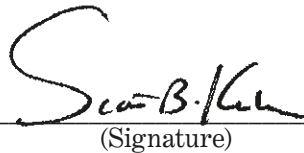

(Signature)

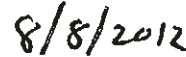


(Date)

CONCURRENCE:

Regional Chief:


(Signature)



(Date)

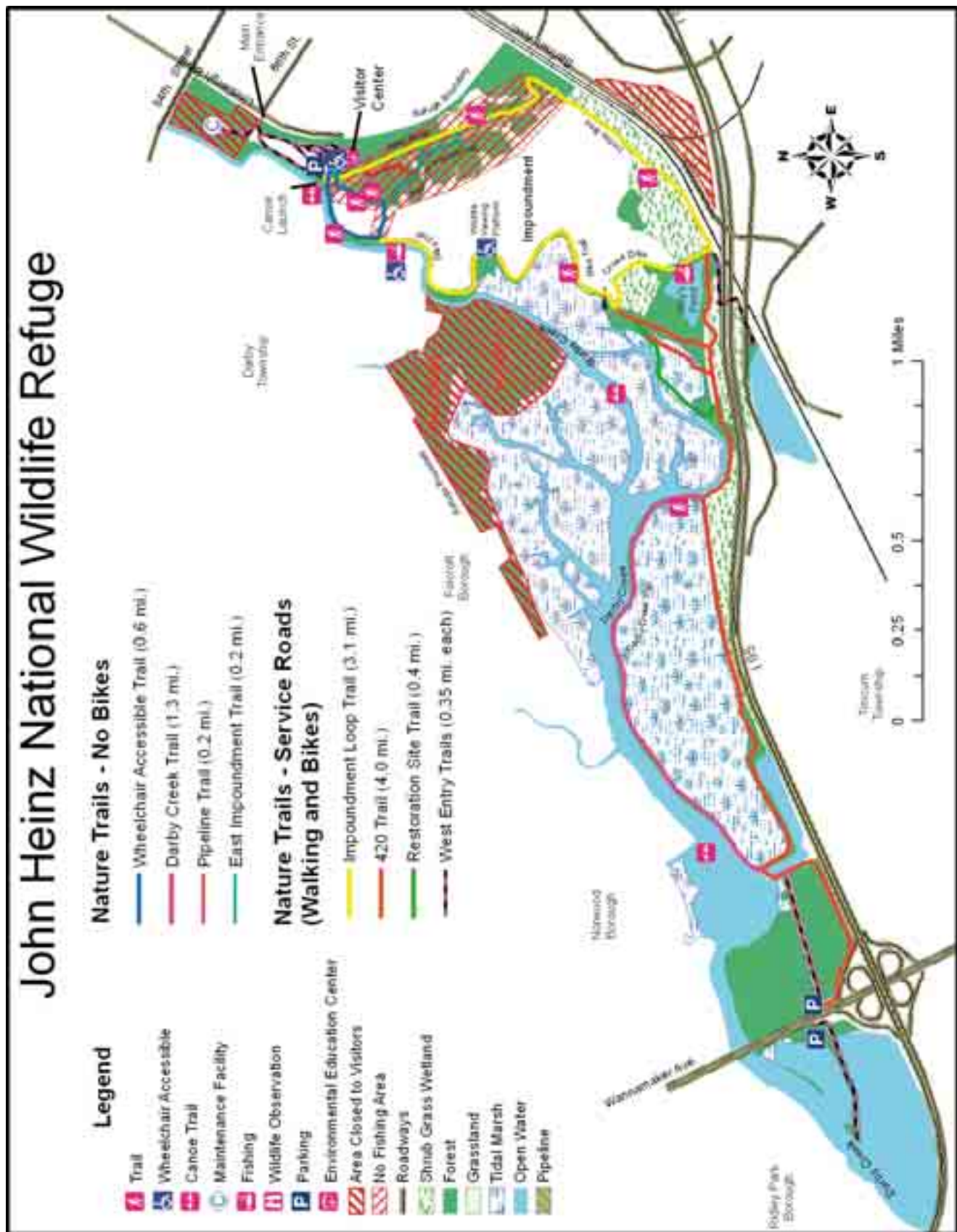
MANDATORY 10 YEAR RE-EVALUATION DATE:



LITERATURE CITED:

- Boyle, S.A., and F.B. Samson. 1985. Effects of nonconsumptive recreation on wildlife: A review. Wildlife Society Bulletin 13:110-116.
- Kuss, F. 1986. A review of major factors influencing plant responses to recreation impacts. Environmental Management 10:638-650.
- Miller, S.G., R.L. Knight, and C.K. Miller. 1998. Influence of Recreational Trails on Breeding Bird Communities. pp. 162-169 (8)1 Ecological Applications.
- . 2001. Wildlife Responses to Pedestrians and Dogs. Wildlife Society Bulletin 29(1): 124-132.
- Purdy, Goff, Decker, Pomerantz, Connelly. 1987. A Guide to Managing Human Activity on a National Wildlife Refuge. New York Cooperative Fish and Wildlife Research Unit.

Map B.4. Access roads and trails where bicycling is authorized on John Heinz NWR



COMPATIBILITY DETERMINATION

USE:

Recreational Fishing

REFUGE NAME:

John Heinz National Wildlife Refuge at Tinicum (John Heinz NWR, refuge)

ESTABLISHING AND ACQUISITION AUTHORITY(IES):

Public Law 92-326 (as amended)

REFUGE PURPOSE(S):

John Heinz NWR (John Heinz NWR, refuge) was established in 1972 under Special Legislation for the following purposes:

- “Preserving, restoring, and developing the natural area known as Tinicum Marsh....a wildlife interpretative center for the purpose of promoting environmental education, and to afford visitors an opportunity for the study of wildlife in its natural habitat.” (86 Stat. 891, dated June 30, 1972).

Additional refuge lands were acquired under the following authorities:

- To be of “particular value in carrying out the national migratory bird management program.” 16 U.S.C. §667b (An Act Authorizing the Transfer of Certain Real Property for Wildlife);
- “[D]evelopment, advancement, management, conservation, and protection of fish and wildlife resources... (16 U.S.C. §742f (a)(4))...for the benefit of the United States Fish and Wildlife Service, in performing its activities and services....” 16 U.S.C. §742f(b)(1) (Fish and Wildlife Act of 1956); and,
- “[F]or use as an inviolate sanctuary, or for any other management purpose, for migratory birds....” 16 U.S.C. §715d (Migratory Bird Conservation Act).

NATIONAL WILDLIFE REFUGE SYSTEM MISSION:

“The mission of the System is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans” (Pub. L. 105–57; 111 Stat. 1252).

DESCRIPTION OF USE:

(a) What is this use? Is it a priority public use?

The use is recreational fishing. Recreational fishing is a priority use of the National Wildlife Refuge System under the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. 668dd-668ee), as amended by the National Wildlife Refuge System Improvement Act of 1997.

(b) Where will the use be conducted?

Recreational fishing access will be allowed in Darby Creek, the Darby Creek side of the 145-acre freshwater impoundment, Long Hook Creek, the main channels of the Tinicum Marsh, and the lagoons at the west end of the refuge adjacent to Hwy 420. Recreational fishing will also be allowed at Hoy's Pond and the 16-Acre Pond (map B.5). There is a handicap accessible fishing site located at the northwest section of the Impoundment Loop Trail, and a fishing pier at Hoy's Pond (see map B.5).

A canoe launch and small dock facility on Darby Creek, adjacent to the main visitor center parking lot, allows fishing access on the water. There are also nearby off-refuge improved launches at commercial marinas further downstream on Darby Creek and the Delaware River.

(c) When will the use be conducted?

Recreational fishing will be permitted when the refuge is open to visitors, daily, year-round, from sunrise to sunset.

(d) How will the use be conducted?

Anglers enter the refuge at the main entrance on Lindbergh Boulevard or at the Hwy 420 west entrance areas for pedestrian traffic and or bicycle access to areas open for public use activities including fishing. Anglers are allowed to fish from stream banks along established trails and access roads, as well as accessing designated fishing areas by boat. The two fishing facilities identified in section (b) are accessible on foot and the handicap accessible fishing facility can also be accessed with wheelchairs and other mobility assistance devices.

As Darby Creek is shallow and tidal, those anglers using non-motorized boats in Darby Creek are encouraged through the refuge brochures, Web page, and visitor center information, to limit use to the 2-hour window on either side of peak high tides for best access. Tide charts are distributed at the refuge visitor center for visitor convenience.

Anglers must comply with applicable State regulations and any refuge-specific regulations if implemented. There is a State consumption advisory on fish from Darby Creek, and signs are posted encouraging catch and release only. No fish stocking is allowed in areas where the Service has jurisdiction. Additional details on recreational fishing on the refuge will be available in the refuge's fishing plan, scheduled to be completed within 3 years of CCP approval.

(e) Why is this use being proposed?

Continued implementation of the refuge fishing program will help the U.S. Fish and Wildlife Service (Service) meet the goal of the National Wildlife Refuge System "... to provide refuge visitors with high quality, safe, wholesome, and enjoyable recreation experiences oriented toward wildlife...."

The refuge fishing program will also help the Service meet the goals of the newly proposed Branch of Recreational Fisheries as stated by Service Director Beattie, "...to provide fishing and aquatic education opportunities to our nation's increasingly urban population...to give children in urban area more opportunities to fish and to learn about aquatic resources."

AVAILABILITY OF RESOURCES:

The resources necessary to provide and administer this use are available within current and anticipated refuge budgets. Staff time associated with administration of this use will be directly related to responding to public inquiries about the program; perform law enforcement patrols; provide signage, environmental education, and Interpretation related to this use; maintenance of parking areas, access roads, and trails to facilitate this public use; and to continue to provide a fishing tackle loaner program for visitors that do not have fishing equipment. The refuge staff annually hosts a Family Fishing Days event that promotes fishing as a family oriented recreational activity as well as introducing intercity youth to the value of fishing as a healthy pastime. Refuge staff will continue to receive assistance from the Pennsylvania Fish and Boat Commission and Pennsylvania Department of Environmental Protection, who have jurisdiction over navigable portions of these waterways.

A canoe launch and small dock facility on Darby Creek, adjacent to the main visitor center parking lot allows fishing access on the water. There are also nearby off refuge improved launches at commercial marinas further downstream on Darby Creek and the Delaware River. We charge no fees for using the refuge canoe launch access area. A pedestrian access fishing pier is available at Hoy's Pond and an accessible fishing deck is available on Darby Creek by the main impoundment water structure. Other open areas are available for bank fishing. The annualized cost associated with the administration of pedestrian travel on the refuge is estimated below:

Providing information to the public and administration needs	=	\$7,000
Resource impacts/monitoring	=	\$2,000
Maintenance needs	=	\$8,000
Total	=	\$17,000

Based on existing refuge expenditures for managing visitor use, funding is adequate to ensure compatibility at the current level of use and to administer and manage the subject use.

ANTICIPATED IMPACTS OF THE USE:

Fishing can affect refuge resources in a number of ways. Studies show that canoes and rowboats disturb wildlife (Bouffard 1982; Kaiser and Fritzell 1984; Knight 1984; Kahl 1991). They may affect waterfowl broods, wintering waterfowl, shorebirds, raptors, and long-legged waders, but their low speed and their use primarily during the warmer months will mitigate those impacts, especially on wintering waterfowl and raptors. Boaters while fishing also may try to access closed portions of the refuge, causing additional disturbance of wildlife. Due to the shallowness of Darby Creek, which can only be physically floated during high tide windows of non-ice seasons, it is anticipated that this use will most likely remain very limited in scope.

The impacts of fishing from non-motorized boating on wildlife include temporary disturbances to species using habitat on Darby Creek and adjacent portions of Tinicum Marsh. These disturbances are likely to be short term and infrequent based on current levels of use.

Waterfowl, wading birds, shorebirds, and other wildlife may be disturbed by human activities. Klein (1993), in a study conducted at J.N. "Ding" Darling National Wildlife Refuge, observed that individuals fishing and crabbing showed the lowest disturbance of wildlife compared to other refuge visitors, presumably because they did not attempt to approach wildlife for photography or observation.

Korschgen and Dahlgren (1992) reported that mallards at Seney National Wildlife Refuge failed to nest in areas open to fishing. Fishing on the refuge is restricted to certain areas to provide adequate nesting sites for waterfowl and other birds. No boats are permitted on the nontidal waters and ponds of the refuge in order to prevent disturbance of nesting birds in remote locations.

Kaiser and Fritzell (1984) found that the number of green-back herons negatively correlated to the number of recreational boaters on water systems. The refuge impoundment where a wading bird colony (including green-backed herons) is located is closed to boating. Most of the small tidal creeks on the refuge are only passable for an hour or two before and after high tide and are rarely frequented by fisherman.

Morton et al. (1989) suggested that human disturbance of wintering black ducks impairs their physiological conditions, thereby reducing winter survival and nutrient reserves carried to the breeding grounds. Because of the climate, little fishing activity occurs on the refuge from the middle of November through the middle of March.

Concern has been expressed over the potential for lead poisoning of waterfowl and wading birds from lead fishing weights. No indication of lead poisoning has been observed at the refuge during more than 20 years of

recreational fishing. Implementation of the U.S. Environmental Protection Agency's proposed regulations on the manufacture of lead fishing weights will virtually eliminate the potential for any impact of lead poisoning resulting from fishing.

Sport fishing should not have any adverse impacts on the fisheries resource at the refuge. Problems associated with site compaction and denuding of vegetation can be addressed by area closures as necessary to protect sensitive areas. Problems associated with littering can be countered through an effective law enforcement program and through public education.

Fishing from shore or non-motorized boats at the refuge will not cause significant impacts to federally listed, threatened or endangered species. The use will be confined to Darby Creek, Darby Creek side of impoundment, Hoy's Pond, 16-Acre Pond, Long Hook Creek, the main channels of the Tinicum Marsh, and lagoons at the west end of the refuge adjacent to Hwy 420. No new construction or vegetation clearing is required. Bald eagles and peregrine falcons (now both delisted) were the only federally listed, threatened or endangered species known to regularly use the refuge for roosting or feeding. Bald eagles are now known (2010) to nest on the refuge. Bald eagles are still protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668c). To ensure refuge activities and visitors do not disturb nesting bald eagles, we comply with the Service's National Bald Eagle Guidelines (USFWS 2007).

Anglers fishing along refuge trails have the potential to impact vegetation through trampling and soil compaction. We anticipate that allowing this use will cause some minor loss of vegetation. However, by restricting visitors to designated trails and roads, we expect these impacts will be negligible. Carlson and Godfrey (1989) documented that management strategies such as constructing elevated boardwalks, fencing sensitive areas, and educating visitors all helped in reducing human impacts to vegetation. Refuge staff will continue to monitor trails and, if any problem areas are identified, will take the appropriate restoration and protection measures.

There are no anticipated impacts on cultural resources.

PUBLIC REVIEW AND COMMENT:

As part of John Heinz NWR's Comprehensive Conservation Plan process, this compatibility determination was released for a 30-day public review and comment period following the release of the draft Comprehensive Conservation Plan and Environmental Assessment.

DETERMINATION (CHECK ONE BELOW):

- ☐ Use is not compatible.
- ☒ Use is compatible, with the following stipulations.

STIPULATIONS NECESSARY TO ENSURE COMPATIBILITY:

- The refuge is closed to all fishing for turtles and frogs to protect the State threatened red-bellied turtle and State endangered coastal plains leopard frog.
- Law enforcement efforts on the refuge will ensure compliance with State laws and refuge-specific regulations including all State fishing license requirements.
- Commercial fishing including crabbing and any take of reptiles or amphibians is prohibited on the refuge.
- Fishing is allowed only during hours when the refuge is open for public use (between sunrise and sunset).

- Parts of the refuge are closed to fishing and additional areas may be closed to provide wildlife sanctuary or prevent habitat damage.
- Vehicle use is limited to parking lot areas. Access to the interior of the refuge (except for designated areas for access for people with disabilities) is limited to foot traffic or bicycling.
- No boats are permitted on the nontidal waters and ponds of the refuge. Boat traffic in the large lagoon and Darby Creek is restricted to “Slow No Wake” speed.
- Fish stocking is not allowed in refuge waters.
- A fishing plan for the refuge will be completed within 3 years of CCP approval.

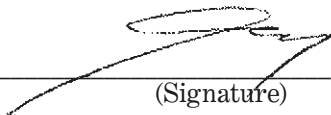
JUSTIFICATION:

Sport fishing is a traditional form of outdoor recreation on the refuge and in the region. Sport fishing on the refuge provides substantial recreational opportunities to the public. A survey conducted by the Service’s Gloucester Point, Virginia Fisheries Assistance Office in June 1994 indicated that the refuge presently has a fisheries resource capable of supporting sustained public use. Refuge staff currently recommends that anglers practice catch and release fishing due to the contaminant warnings issued by the Commonwealth of Pennsylvania for the Delaware River Watershed from the mouth of Delaware Bay to Trenton, New Jersey.

Recreational fishing has been determined to be compatible provided the stipulations necessary to ensure compatibility are implemented, and the use does not exceed thresholds necessary for visitor safety and resource protection. Recreational fishing is a priority public use on the refuge and it is not expected to materially interfere with or detract from the mission of the National Wildlife Refuge System nor diminish the purposes for which the refuge was established, will not pose significant adverse effects on refuge resources, will not interfere with other public uses of the refuge, nor cause an undue administrative burden.

SIGNATURE:

Refuge Manager: _____

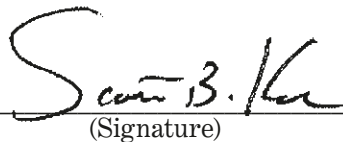

(Signature)

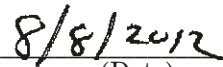


(Date)

CONCURRENCE:

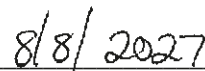
Regional Chief: _____


(Signature)



(Date)

MANDATORY 15 YEAR RE-EVALUATION DATE:

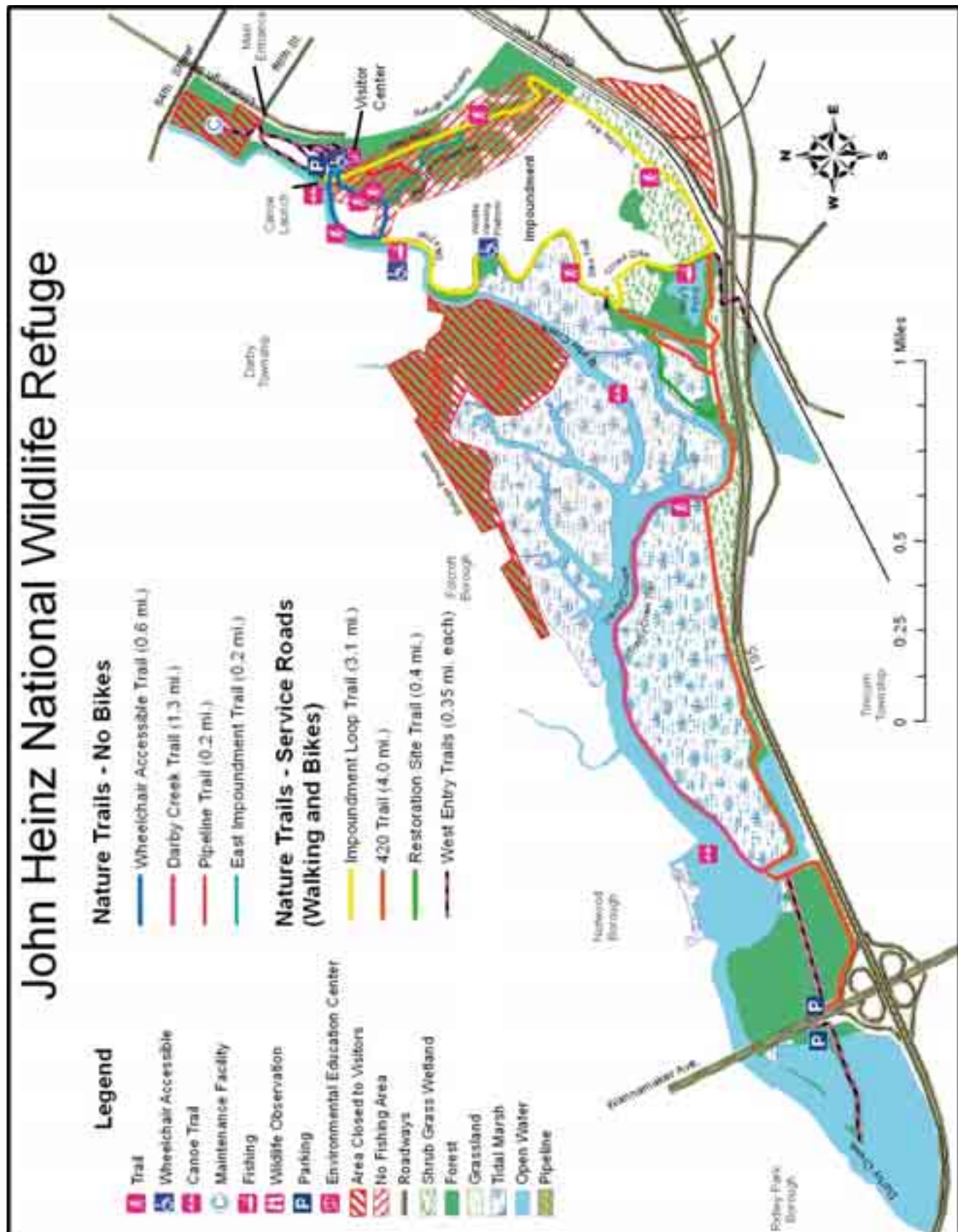


LITERATURE CITED:

- Bouffard S.H. 1982. Wildlife values versus human recreation: Ruby Lake National Wildlife Refuge. Trans. North American Wildlife and Natural Resources Conference 47:553-558.
- Kaiser, M.S., and E.K. Fritzell. 1984. Effects of river recreationists on green-backed herons behavior. J. Wildlife Management 48:561-567.

- Kaiser, M.S., and E.K. Kaiser. 1984. Effects of river recreationists on green-backed heron behavior. *J. Wildlife Management* 48:561-567.
- Kahl, R. 1991. Boating disturbance of canvasbacks during migration at Lake Poygan, Wisconsin. *Wildlife Society Bulletin* 19:243-248.
- Klein, M.L. 1993. Waterbird behavioral responses to human disturbances. *Wildlife Society Bulletin* 21:31-39.
- Korschgen, C.E., and R.B. Dahlgren. 1992. Human disturbance of Waterfowl: Causes, effects, and management. *Waterfowl Management Handbook*, U.S. Fish and Wildlife Service Leaflet 13.2.15. 8pp.
- Knight, R.L. 1984. Responses of wintering bald eagles to boating activity. *J. Wildlife Management*. 48:999-1004.
- Morton, J.M., A.C. Fowler, and R.L. Kirkpatrick. 1989. Time and energy budgets of American black ducks in winter. *J. Wildlife Management* 53:401-410.
- U.S. Fish and Wildlife Service (USFWS). 2007. National Bald Eagle Management Guidelines May 2007. Accessed online May 2011 <<http://www.fws.gov/midwest/eagle/guidelines/index.html>>.

Map B.5. Visitor facilities at John Heinz NWR



COMPATIBILITY DETERMINATION

USE:

Wildlife Observation, Photography, Environmental Education, and Interpretation

REFUGE NAME:

John Heinz National Wildlife Refuge at Tinicum (John Heinz NWR, refuge)

ESTABLISHING AND ACQUISITION AUTHORITY(IES):

Public Law 92-326 (as amended)

REFUGE PURPOSE(S):

John Heinz NWR (John Heinz NWR, refuge) was established in 1972 under Special Legislation for the following purposes:

- “Preserving, restoring, and developing the natural area known as Tinicum Marsh....a wildlife interpretative center for the purpose of promoting environmental education, and to afford visitors an opportunity for the study of wildlife in its natural habitat.” (86 Stat. 891, dated June 30, 1972).

Additional refuge lands were acquired under the following authorities:

- To be of “particular value in carrying out the national migratory bird management program.” 16 U.S.C. §667b (An Act Authorizing the Transfer of Certain Real Property for Wildlife);
- “[D]evelopment, advancement, management, conservation, and protection of fish and wildlife resources... (16 U.S.C. §742f (a)(4))...for the benefit of the United States Fish and Wildlife Service, in performing its activities and services....” 16 U.S.C. §742f(b)(1) (Fish and Wildlife Act of 1956); and,
- “[F]or use as an inviolate sanctuary, or for any other management purpose, for migratory birds....” 16 U.S.C. §715d (Migratory Bird Conservation Act).

NATIONAL WILDLIFE REFUGE SYSTEM MISSION:

“The mission of the National Wildlife Refuge System is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans” (Pub. L. 105–57; 111 Stat. 1252).

DESCRIPTION OF USE:

(a) What is this use? Is it a priority public use?

The use is to permit wildlife observation, photography, environmental education, and interpretation (formal and non-formal, personal and non-personal) within the boundaries of John Heinz NWR as activities which increase the public’s knowledge, understanding, and appreciation of wildlife while contributing to conservation of natural resources. Activities include traditional environmental education activities (teacher-led or staff-led onsite field trips); nature study, such as teacher and student workshops; and interpretation of the wildlife resource and

support facilities such as the visitor center, boardwalks, observation decks, photography blinds, interpretive displays, guided walks, and programs. Wildlife observation, photography, environmental education, and interpretation are all priority public uses of the National Wildlife Refuge System under the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. 668dd-668ee), as amended by the National Wildlife Refuge System Improvement Act of 1997.

(b) Where will the use be conducted?

Wildlife observation, photography, environmental education, interpretation programs, and activities will be allowed along refuge roads, trails, parking areas, and other areas open to public use (e.g., Darby Creek). This also includes facilities such as the visitor center, classrooms, pavilion, boardwalks, wildlife viewing decks, fishing piers, photo blinds, and other onsite facilities that are developed (see map B.6) along with offsite programs within scope of available staff, volunteers, and budgets.

(c) When will the use be conducted?

Wildlife observation, photography, environmental education, and interpretation will be permitted when the refuge is open to visitors, daily, year-round, from sunrise to sunset. Occasional guided evening programs (some coupled with wildlife population counts) are also offered to include staff or trained volunteer-led, citizen science activities such as surveys for vocalizing anurans and nocturnal avian fauna. Cross-country skiing and snowshoeing occur in winter when there is sufficient snow to allow these activities.

(d) How will the use be conducted?

Visitors are allowed to participate in these activities by walking or hiking, cross-country skiing, snowshoeing, and volunteer or staff-led tours on designated roads and trails. Visitors with limited mobility may also participate using approved mobility assistance devices (i.e., wheelchairs, scooters). Cross-country skiing and snowshoeing are limited to winter when there is sufficient snow to allow these activities. Refuge staff does not groom trails in the winter, so access may be limited.

(e) Why is this use being proposed?

Wildlife observation, photography, environmental education, and interpretation are all priority public uses as authorized under the Refuge Improvement Act, and are included or support the primary purposes for which the refuge was established. Continued implementation of the refuge wildlife observation, photography, environmental education, and interpretation programs will help the Service meet the goal of the National Wildlife Refuge System “... to provide refuge visitors with high quality, safe, wholesome, and enjoyable recreation experiences oriented toward wildlife....”

Providing opportunities for wildlife observation, photography, environmental education, and interpretation is included within the refuge’s primary purposes in its establishing legislation (see section entitled “Purpose(s) for which Established” above). Contact with refuge visitors engaged in these activities also provides opportunities for the refuge to interpret refuge-specific issues and the goals of the U.S. Fish and Wildlife Service (Service). Visitors need to access areas of the refuge to participate in these activities, usually by foot (walking, skiing, snowshoeing), or mobility assistance equipment (scooters, wheelchairs etc.).

Continued implementation of these programs will help the Service meet the goal of the National Wildlife Refuge System, “...to provide an understanding and appreciation of fish and wildlife ecology and man’s role in his environment....”

AVAILABILITY OF RESOURCES:

Wildlife observation, photography, environmental education, and interpretation are all priority public uses directly supporting primary purposes for which the refuge was established. The resources necessary to provide and administer this use are available within current and anticipated refuge budgets. Staff time associated with administration of this use will be directly related to responding to public inquiries about the program; law enforcement patrols; maintenance and construction of adequate facilities for these uses; develop and implement environmental education and interpretive programs; maintenance of parking areas, access roads, and trails

to facilitate this public use; and continuing to provide a binocular loaner program for visitors that do not have necessary equipment. Refuge personnel directly coordinate and maintain these priority public use programs and facilities and are supplemented by numerous volunteers and partner agencies and organizations. We charge no fees for using the refuge facilities. The annualized cost associated with the administration of pedestrian travel on the refuge is estimated below:

Providing information to the public, program development and implementation, and administration needs	=	\$250,000
Resource impacts/monitoring	=	\$5,000
Maintenance needs	=	\$25,000
Total	=	\$280,000

Based on existing refuge expenditures for managing visitor use, funding is adequate to ensure compatibility at the current level of use and to administer and manage the subject use.

ANTICIPATED IMPACTS OF THE USE:

The use of onsite, hands-on, action-oriented activities by groups of up to 200 students and teachers to accomplish environmental education objectives may impose a low level of impact on the sites used for these activities.

Effects on Soils and Vegetation: Visitors engaged in these uses along refuge trails have the potential to impact vegetation through trampling and soil compaction. We anticipate that allowing this use will cause some minor loss of vegetation. However, by restricting visitors to designated trails and roads, we expect these impacts will be negligible. Carlson and Godfrey (1989) documented that management strategies such as constructing elevated boardwalks, fencing sensitive areas, and educating visitors all helped in reducing human impacts to vegetation. In addition, cross-country skiing and snowshoeing are limited to winter months and require sufficient snow cover to allow access. Surface water and soils are often frozen for at least a portion of this time, most vegetation is dormant, and sensitive habitat will be protected by a layer of snow. Skis and snowshoes are also designed to distribute weight, decreasing the risk of erosion near waterways. Refuge staff will continue to monitor trails and, if any problem areas are identified, will take the appropriate restoration and protection measures.

Effects on Wildlife: Wildlife observation, photography, environmental education, and interpretation use within designated areas open to public use will not cause significant impacts to threatened or endangered species. There are currently no known federally listed species on the refuge. Two recently delisted species, the bald eagle and peregrine falcon, use the refuge for roosting and feeding. Bald eagles also now nest on the refuge.

In general, the presence of humans disturbs most wildlife, which typically results in a temporary displacement without long-term effects on individuals or populations. Disturbance varies by wildlife species involved and the type, level, frequency, duration and the time of year activities occur. Disturbance can cause shifts in habitat use, abandonment of habitat, and increased energy demands on affected wildlife (Knight and Cole 1991). Miller et al. (1998) found bird abundance and nesting activities (including nest success) increased as distance from a recreational trail increased in both grassland and forested habitats. In this study, common species (e.g., American robins) were found near trails and rare species (e.g., Blackburnian warblers) were found farther from trails. In some cases there is a clear link between the extent of disturbance and either the survival or reproductive success of individuals (e.g., Schulz and Stock 1993), but in many cases disturbance acts in a more subtle way, by reducing access to resources such as food supplies or nesting sites (Gill et al. 1996). Bird flight in response to disturbance can lower reproductive success by exposing individuals and nests to predators.

For recreation activities that occur simultaneously (hiking, biking, and horseback riding) there will likely be compounding negative impacts to wildlife (Knight and Cole 1991).

Wildlife disturbance may be compounded by seasonal needs. For example, some species such as warblers, could be negatively affected by disturbance associated with bird watching particularly during the breeding season. When visitors approach nests too closely, they often cause the adult bird to flush, exposing the eggs to weather conditions or predators (Banks and Bryant 2007, Miller et al. 2001). The extent of that disturbance along the trail also depends on visibility and the density of vegetation. For songbirds, Gutzwiller et al. (1994) found that low levels of human intrusion altered the singing behavior of some species. Disturbance may also affect the reproductive fitness of males by hampering territory defense, mate selection, and other reproductive functions of vocalizations (Arrese 1987). Disturbance, which leads to reduced singing activity, will make males rely more heavily on physical deterrents to defend territories, which consume more time and energy than singing (Ewald and Carpenter 1978).

The refuge is located in a highly urban environment, with substantial baseline disturbance associated with the international airport, I-95, several State routes, and numerous houses, businesses, community buildings, and associated human activity. By limiting the presence of humans to refuge trails and infrastructure, refuge visitors are not expected to add significantly to existing disturbance levels. Overall, the direct disturbance from public use is expected to have minimal or no adverse effects on wildlife. We will evaluate the sites and programs periodically to assess whether they are meeting the objectives, and to prevent site degradation. If the use causes evident and unacceptable adverse impacts, the refuge will rotate the activities to secondary sites, or curtail or discontinue them.

Bennett and Zuelke (1999) summarize several studies indicating recreation activities will have at least temporary effects on the behavior and movement of birds using shallow water habitats adjacent to trails and roads through wildlife refuges (Burger 1981, 1986; Klein 1993; Burger et al. 1995; Klein et al. 1995; Rodgers and Smith 1997; Burger and Gochfeld 1998). We will take all necessary measures to mitigate those effects, particularly where group educational activities are involved. We will evaluate the sites and programs periodically to assess whether they are meeting the objectives, and to prevent site degradation. If the use causes evident and unacceptable adverse impacts, the refuge will rotate the activities to secondary sites, or curtail or discontinue them.

It is important to note that the refuge exists within a highly altered area with substantial baseline levels of disturbance associated with interstate traffic, airport activities, adjacent neighborhoods and roads. Overall, the effects from public use are expected to have minimal adverse effects on birds utilizing open water and wetland habitats. There are few visitor facilities (e.g., trails) in these habitats due to the presence of open water and saturated soils; therefore, they are relatively inaccessible to the public. The size and dense vegetation supported by freshwater tidal marsh and portions of open water should provide adequate buffers to protect wetland bird species like American bittern against human disturbance (Gibbs and Melvin 1992). Boaters that access the refuge from Darby Creek could disturb species using these habitats. The refuge does not own or control access for most of Darby Creek. We do post speed limits for motorized boats within refuge waters to minimize disturbance to wildlife and habitats.

Effects of cross-country skiing and snowshoeing on wildlife are also considered to be minimal. Most mammal species are less active during winter months, and it is not breeding season for any of the wildlife that may be present. Many of the sensitive migratory bird species have already left the refuge, those that remain. Also, while we do not count the number of participants in these activities, refuge staff have observed few visitors skiing or snowshoeing on the refuge. Lastly, annual snowfall averages 20.5 inches in Philadelphia (NOAA 2008). Consequently, disturbance to wildlife associated with these activities is limited to only a few days on the refuge with sufficient snow cover to allow skiing and snowshoeing.

Pedestrian use of the designated access roads and trails will not cause significant impacts to threatened or endangered species. The use will be confined to existing roads and no new construction or vegetation clearing is required. Bald eagles and peregrine falcons are the only former federally listed, threatened or endangered species known to use the refuge for roosting or feeding. Bald eagles now nest on the refuge and both species have been delisted under the Federal Endangered Species Act. Bald eagles are still protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668c). To ensure refuge activities and visitors do not disturb nesting bald eagles, we comply with the Service's National Bald Eagle Guidelines (USFWS 2007).

Disturbance of wildlife can be minimized by seasonal or permanent closure of areas, interpretative displays, and inclusion in all visitor service programs and publications provided. Impacts to vegetation and soils can be alleviated by rotation of the areas used for educational activities, scheduling of groups, and providing teachers with information on a variety of activities.

Effects on Cultural Resources: There are no anticipated impacts to cultural resources.

PUBLIC REVIEW AND COMMENT:

As part of John Heinz NWR's Comprehensive Conservation Plan process, this compatibility determination was released for a 30-day public review and comment period following the release of the draft Comprehensive Conservation Plan and Environmental Assessment.

DETERMINATION (CHECK ONE BELOW):

- ☐ Use is not compatible.
- ☒ Use is compatible, with the following stipulations.

STIPULATIONS NECESSARY TO ENSURE COMPATIBILITY:

- Access to the refuge (other than parking areas) is restricted to foot, non-powered transportation, or powered scooters or wheelchairs.
- A limitation of 200 students per day should be retained.
- Impacts must be monitored to identify problems and areas may be closed to provide wildlife sanctuary or prevent habitat damage.
- Other than refuge-specific programs led by staff or volunteers, wildlife observation, photography, environmental education, and interpretation will only be allowed on designated trails, roads, and facilities. Activities beyond these facilities will only be allowed by individuals that have been issued a special use permit.
- Impacts will be monitored to identify problems and areas may be closed to provide wildlife sanctuary or prevent habitat damage.
- To counter associated problems, we will include enforcing refuge trash disposal guidelines in our law enforcement program and will include information about proper trash disposal in all visitor services programs and publications.

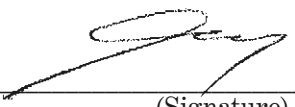
JUSTIFICATION:

Wildlife observation, photography, environmental education, and interpretative programs are a primary purpose for which John Heinz NWR was established; therefore, they must be compatible with the purpose for which the refuge was established.

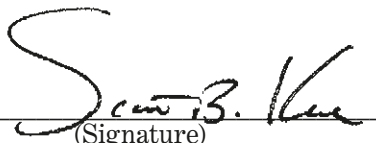
These activities are low impact activities on the refuge. Cooke (1980) reported that passerine birds in suburban areas where human activity is ubiquitous habituate to the activities and are not disturbed as often as birds in rural areas. Waterfowl, wading birds, shorebirds, and other wildlife may be disturbed by human activities; however, portions of the refuge are not readily accessible to visitors and provide sanctuary from human activities for wildlife.

Wildlife observation, photography, environmental education, and interpretation have been determined to be compatible provided the stipulations necessary to ensure compatibility are implemented, and the use does not exceed thresholds necessary for visitor safety and resource protection. Wildlife observation, photography, environmental education, and interpretation are priority public uses on the refuge and are not expected to materially interfere with or detract from the mission of the National Wildlife Refuge System nor diminish the purposes for which the refuge was established, will not pose significant adverse effects on refuge resources, will not interfere with other public uses of the refuge, nor cause an undue administrative burden.

SIGNATURE:

Refuge Manager:  (Signature) 7/17/2012 (Date)

CONCURRENCE:

Regional Chief:  (Signature) 8/8/2012 (Date)

MANDATORY 15 YEAR RE-EVALUATION DATE:

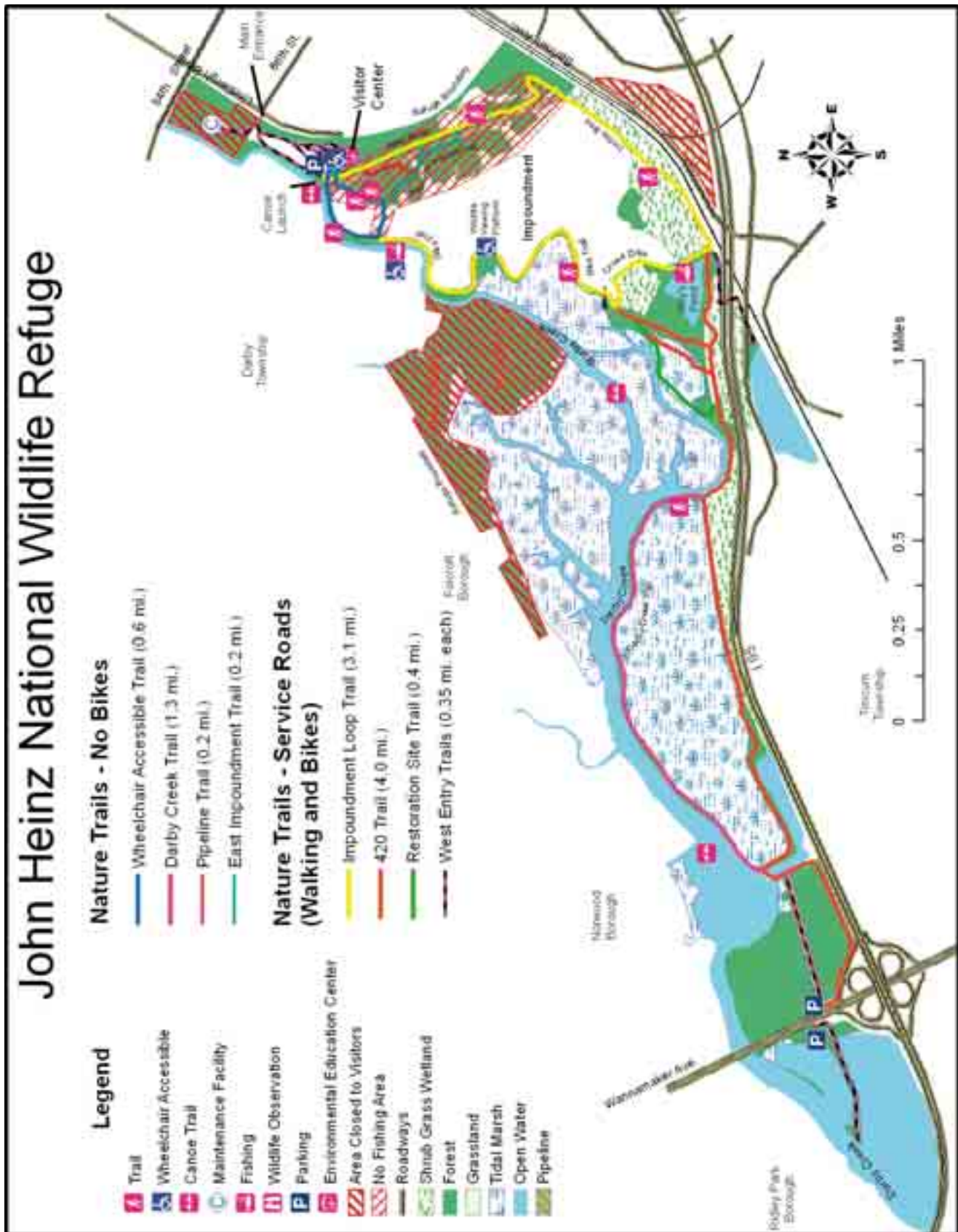
8/8/2027

LITERATURE CITED:

- Arrese, P. 1987. Age, intrusion pressure and defense against floaters by territorial male Song Sparrows. *Animal Behavior* 35:773-784.
- Belanger, L., and J. Bedard. 1990. Energetic cost of man-induced disturbance to staging snow geese. *J. Wildlife Management* 54:36.
- Bennett, K., and E. Zuelke. 1999. The Effects of Recreation on Birds: A Literature Review. Unpublished report. Submitted to: DE Division of Parks and Recreation, DNREC.
- Boyle, S.A., and F.B. Samson. 1985. Effects of nonconsumptive recreation on wildlife: A review. *Wildlife Society Bulletin* 13:110-116.
- Burger, J. 1981. Effect of human activity on birds at a coastal bay. *Biological Conservation* 21:231-241.
- . 1986. The effect of human activity on shorebirds in two coastal bays in northeastern United States. *Biological Conservation* 13:123-130.
- Burger, J., and M. Gochfeld. 1981. Discrimination of the threat of direct versus tangential approach to the nest by incubating herring and great black-backed gulls. *Journal of Comparative Physiological Psychology* 95:676-684.

- . 1998. Effects of Ecotourists on Birds at Loxahatchee Natural Wildlife Refuge. *Environmental Conservation* 25: 13-21.
- Burger, J., M. Gochfeld, and L.J. Niles. 1995. Ecotourism and birds in coastal New Jersey: Contrasting responses of birds, tourists, and managers. *Environmental Conservation* 22:56-65.
- Carlson, L.H., and P.J. Godfrey, 1989. Human impact management in a coastal recreation and natural area. *Biological Conservation* 49(2): 141-156.
- Cooke, A.S. 1980. Observations on how close certain passerine species will tolerate an approaching human in rural and suburban areas. *Biological Conservation* 18:85-88.
- Erwin, R.M. 1980. Breeding habitat by colonially nesting water birds in 2 mid-Atlantic U.S. regions under different regimes of human disturbance. *Biological Conservation*. 18:39-51.
- Ewald P.W., and F.L. Carpenter. 1978. Territorial responses to energy manipulations in the Anna hummingbird. *Oecologia* 31: 277-292.
- Gibbs, J.P., and S. Melvin. 1992. American Bittern. Pp 51-88 in K.J. Schneider and D.M. Pence (eds.) *Migratory Nongame Birds of Management Concern in the Northeast*. 1992 U.S. Fish and Wildlife Service, Newton Corner, MA. 400p.
- Hammitt, W.E., and D.N. Cole. 1998. *Wildland Recreation: Ecology and Management*. 2nd ed. New York: John Wiley and Sons. 361 pp.
- Knight, R.L., and D.N. Cole. 1991. Effects of recreational activity on wildlife in wildlands. *Transactions, 56th North American Wildlife and Natural Resources Conference*, 1991, p. 238-247. Washington, D.C. Wildlife Management Institute.
- National Oceanic and Atmospheric Administration (NOAA). 2008. Snowfall – Average Total In Inches. [Online accessed December 29, 2011]. <<http://lwfncdc.noaa.gov/oa/climate/online/ccd/snowfall.html>>

Map B.6. Visitor facilities at John Heinz NWR



Appendix C

Frank Miles/USFWS



Yellow-rumped warbler

Final Habitat Management Plan

John Heinz National Wildlife Refuge at Tinicum Habitat Management Plan

August 2012



The National Wildlife Refuge System, managed by the U.S. Fish and Wildlife Service, is the world's premier system of public lands and waters set aside to conserve America's fish, wildlife and plants. Since the designation of the first wildlife refuge in 1903, the System has grown to encompass more than 150 million acres, over 550 national wildlife refuges and other units of the Refuge System, plus 37 wetland management districts



U.S. Fish & Wildlife Service

John Heinz National Wildlife Refuge at Tinicum

Final Habitat Management Plan

August 2012

Submitted by:

Gary M. Stolz
Refuge Manager
John Heinz National Wildlife Refuge at Tinicum

7/17/2012

Date

Concurrence by:

Jan D. Taylor
Chief, Division of Natural Resources, Region 5
National Wildlife System

7/30/2012

Date

Susan R. McMahon
Deputy Regional Chief, Region 5
National Wildlife System

7/30/12

Date

Approved by:

Scott B. Kahan
Regional Chief, Region 5
National Wildlife System

8/6/2012

Date

Table of Contents

Chapter 1. Introduction	C-7
1.1 Scope and Rationale	C-8
1.2 Legal Mandates	C-8
1.3 Relation to Other Plans	C-8
 Chapter 2. Background	 C-13
2.1 Refuge Location and Description	C-14
2.2 Geographical Setting	C-14
2.3 Historical Perspective	C-18
2.4 Climate Influences and Natural and Anthropogenic Disturbances	C-22
2.5 Current Refuge Conditions	C-22
 Chapter 3. Resources of Concern	 C-37
3.1 Introduction	C-38
3.2 Potential Resources of Concern	C-38
3.3 Biological Integrity, Diversity, and Environmental Health	C-40
3.4 Priority Resources of Concern	C-44
3.5 Priority Habitat Types and Associated Focal Species	C-46
3.6 Conflicting Habitat Needs	C-51
3.7 Adaptive Management	C-52
 Chapter 4. Habitat Goals and Objectives	 C-53
4.1 Background	C-54
4.2 Habitat Goals and Objectives	C-54
<u>Coastal Plain Ecological Communities</u>	
Objective 1.1 Freshwater Tidal Marsh	C-54
Objective 1.2 Coastal Plain and Floodplain Forests	C-55
Objective 1.3 Darby Creek	C-58
<u>Human Modified Habitats</u>	
Objective 2.1 Impoundment and Nontidal Open Water	C-59
Objective 2.2 Wet Meadows, Grasslands, and Early Successional Habitats	C-62
 Chapter 5. Management Strategies and Prescriptions	 C-65
5.1 Development of Management Strategies and Prescriptions	C-66
5.2 Management Units	C-66
5.3 Management Strategies and Prescriptions by Habitat Objective	C-70
<u>Coastal Plain Ecological Communities</u>	
Objective 1.1 Freshwater Tidal Marsh	C-70
Objective 1.2 Coastal Plain and Floodplain Forests	C-71
Objective 1.3 Darby Creek	C-72
<u>Human Modified Habitats</u>	
Objective 2.1 Impoundment and Nontidal Open Water	C-73
Objective 2.2 Wet Meadows, Grasslands, and Early Successional Habitats	C-75

Appendix A. Plan Development Team	C-83
Appendix B. Potential Habitat Management Strategies	C-84
Appendix C. Resources of Concern for John Heinz National Wildlife Refuge	C-97
Appendix D. Known Vegetation of John Heinz National Wildlife Refuge	C-106
Appendix E. Nonbird Animal Species of John Heinz National Wildlife Refuge	C-110

List of Maps

Map C.1. Location of John Heinz National Wildlife Refuge	C-16
Map C.2. Bird Conservation Regions in Relation to John Heinz National Wildlife Refuge	C-17
Map C.3. Plant Communities of John Heinz National Wildlife Refuge	C-29
Map C.4. Existing Grassland Habitats at John Heinz National Wildlife Refuge	C-64
Map C.5. Habitat Management Units as Defined by the Habitat Management Plan	C-67

List of Figures

Figure C.1. Historic Maps of Philadelphia Region	C-19
Figure C.2. Aerial photograph of John Heinz National Wildlife Refuge lands in 1928	C-20
Figure C.3. Monitored sea levels at Philadelphia (1900–2000)	C-22
Figure C.4. Shorebird, waterfowl, and wader abundance (adjusted for partial observability) and water gauge levels within the 145-acre impoundment at John Heinz National Wildlife Refuge.	C-61

List of Tables

Table C.1. Broad Habitat Types and National Vegetation Classification System Associations and Alliances Found Within John Heinz National Wildlife Refuge	C-28
Table C.2. Fish Species and Utilization of Lower Darby Creek and Freshwater Tidal Marsh Habitats	C-33
Table C.3. Invasive Species Identified at John Heinz National Wildlife Refuge and Their Associated Management Ranking.	C-35
Table C.4. Summary of Habitats that Represent Existing BIDEH for John Heinz National Wildlife Refuge.	C-41
Table C.5. Priority Resources of Concern and Associated Focal Species for John Heinz National Wildlife Refuge.	C-45
Table C.6. Focal Species, Associated Habitat Requirements, and Other Species Benefitting from Habitat Management at John Heinz National Wildlife Refuge.	C-47
Table C.7. Priority Habitats and Their Potential Limiting Factors at John Heinz National Wildlife Refuge.	C-50
Table C.8. Bird Groups and Optimal Conditions for Migratory Stopover and Forage Enhancement within the Impoundment	C-60
Table C.9. Management Units at John Heinz National Wildlife Refuge	C-68

Chapter 1. Introduction

1.1 Scope and Rationale

1.2 Legal Mandates

1.3 Relation to Other Plans

1.1 Scope and Rationale

John Heinz National Wildlife Refuge at Tinicum (John Heinz NWR, the refuge) was created in 1972 for the purpose of preserving, restoring, and developing the natural area known as Tinicum Marsh. It was created to develop a wildlife interpretative center for the purpose of promoting environmental education and to afford visitors an opportunity to study wildlife in its natural habitat. The refuge protects approximately 200 acres of the remaining freshwater tidal marsh in Pennsylvania and represents an important migratory stopover along the Atlantic Flyway. It also provides protected breeding habitat for State-listed threatened and endangered species, as well as many neotropical migrants (Cohen and Johnson 2004).

John Heinz NWR is managed by the U.S. Fish and Wildlife Service (Service, we, our) as part of the National Wildlife Refuge System (Refuge System). The Refuge System maintains the biological integrity, diversity and environmental health of these natural resources for the benefit of present and future generations.

The refuge protects a variety of unique resources and also provides a unique opportunity for the education and outreach near the urban center of the city of Philadelphia, the nation's fifth largest metropolitan area. Sustaining and protecting these resources requires planning, active on-the-ground management, and partnerships with the surrounding communities of the Delaware Valley. This Habitat Management Plan (HMP) provides a long-term vision and specific guidance on managing the habitats for the identified resources of concern at John Heinz NWR. The HMP will provide direction for the next 15 years. Interim reviews and use of adaptive management will assess and modify management activities as research, monitoring, and priorities require.

1.2 Legal Mandates

John Heinz NWR was created in 1972 for three primary purposes:

1. "Preserving, restoring, and developing the natural area known as Tinicum Marsh....a wildlife interpretative center for the purpose of promoting environmental education, and to afford visitors an opportunity for the study of wildlife in its natural habitat." (86 Stat. 891, dated June 30, 1972).
2. To be of "particular value in carrying out the national migratory bird management program." 16 U.S.C. § 667b (An Act Authorizing the Transfer of Certain Real Property for Wildlife).
3. "Development, advancement, management, conservation, and protection of fish and wildlife resources... (16 U.S.C. § 742f(a)(4))...for the benefit of the United States Fish and Wildlife Service, in performing its activities and services...(16 U.S.C. § 742f(b)(1)) (Fish and Wildlife Act of 1956).

In 1997, Congress passed the National Wildlife Refuge System Improvement Act (Refuge Improvement Act), establishing a unifying mission for the Refuge System. The Refuge Improvement Act highlights six priority public uses that each refuge should evaluate for compatibility with its wildlife-first mandate. These six public uses include wildlife observation, interpretation, photography, environmental education, hunting, and fishing. The act requires that all refuges prepare a Comprehensive Conservation Plan (CCP) by 2012. John Heinz NWR began the CCP planning process in 2010.

1.3 Relation to Other Plans

Important guidance for wildlife habitat management at John Heinz NWR has already been provided by several important refuge, regional, and national plans.

Refuge Plans

Comprehensive Conservation Plan

The Refuge Improvement Act requires that all refuges prepare a CCP by 2012. The CCP guides biological and public use actions on the refuge for a 15-year period. John Heinz NWR is scheduled to complete the CCP planning process in 2012. The goals and objectives developed as part of this HMP will be incorporated into the CCP.

Restoration Management Plan for the Lower Darby Creek with Recommendations for John Heinz National Wildlife Refuge at Tinicum (Salas et al. 2006)

This restoration management plan was developed in 2006 by the Delaware Riverkeeper Network under a Delaware Estuary Grant awarded to the Friends of the Heinz Refuge and funded by the National Fish and Wildlife Foundation. The purpose of this plan was to initiate an ecological restoration approach to habitat management at the refuge. This plan identified historic disturbances to the site, the ecological communities existing at the refuge, and provided recommendations for the restoration of the more natural ecological composition, structure, and function of these communities. The extensive field and GIS data, along with historic records and information compiled as part of this plan, were used extensively in the development of the HMP.

Pennsylvania Important Bird Area #73: Phase I Conservation Plan (Cohen and Johnson 2004)

John Heinz NWR is designated an Important Bird Area by the National Audubon Society for its critical location within the Atlantic flyway and its complex of unique habitats. This Phase I Conservation Plan identifies habitat-based site boundaries, describes the birds and wildlife habitat which occur on the site with special reference to the species for which the site was selected as an Important Bird Area, identifies conservation issues and threats to the site, and provides recommendations for conservation actions. Its conservation recommendations are being considered with those of other refuges and regional plans.

Final White-tailed Deer Management Plan (D'Angelo 2012)

Refuge staff consulted with U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service, Wildlife Services (APHIS-WS) to study the deer population present at John Heinz NWR and the effects of deer on refuge habitat, wildlife, and humans. The purpose of the deer management plan is to institute a sound biological program to efficiently manage the deer population within a sustainable and healthy balance within the habitat and objectives of the refuge.

Regional and National Plans

North Atlantic Landscape Conservation Cooperative Operations Plan (USFWS 2009a)

The Service is developing a coordinated network of landscape conservation cooperatives across the U.S., in part to address major environmental and human-related factors that limit fish and wildlife populations at the broadest of scales, including developing adaptation strategies in response to climate change. The landscape conservation cooperative is utilizing principles of strategic habitat conservation to develop and communicate landscape-scale scientific information to shape conservation across the northeastern U.S. This initial plan outlines the regional threats to conservation, priority species and habitats, as well as active regional partnerships.

Mid-Atlantic Coast Bird Conservation Region 30 Implementation Plan (USFWS 2008a)

The Implementation Plan for the Bird Conservation Region (BCR) 30 combines regional plans, assessments, and research completed over the past two decades to develop continental-based bird conservation efforts. John Heinz NWR is located within the narrow portion of the Mid-Atlantic Coastal Plain located in southeastern Pennsylvania. As such, this coastal zone is unique to the State of Pennsylvania and thus many of the priority species listed for BCR 30 are also species of concern listed within the Pennsylvania Wildlife Action Plan. These rankings and the recommendations of the inventory have been considered along with other local and regional conservation priorities.

A Natural Heritage Inventory of Philadelphia County, Pennsylvania (PNHP 2008)

The Philadelphia County Natural Heritage Inventory was compiled by the Pennsylvania Department of Conservation and Natural Resource (PADCNR) Natural Heritage Program and the Western Pennsylvania Conservancy. It provides information on the general locations of rare, threatened, and endangered species, of the highest quality natural areas in the county, and identifies areas in need of restoration. The Pennsylvania Natural Heritage Program also provides State conservation rankings for each species of conservation concern in Pennsylvania. These rankings and the recommendations of the inventory have been considered along with other local and regional conservation priorities.

Pennsylvania Wildlife Action Plan (PGC and PFBC 2005)

The State Wildlife Action plan was completed in 2005 and updated again in 2008 (Pennsylvania Game Commission (PGC) and Pennsylvania Fish and Boat Commission (PFBC) 2008). While creating a strategic focus for State fish and wildlife management agencies, this plan attempts to provide a Statewide perspective on conservation, presenting geographic, species, and habitat priorities. Considering John Heinz NWR's protection of habitats unique to the State of Pennsylvania, species of conservation priority were considered in development of the refuge's resources of concern.

Service Migratory Bird Program Strategic Plan (USFWS 2004)

The Migratory Bird Program Strategic Plan provides direction for the Service's migratory bird management over the next decade (2004 to 2014). The plan contains a vision and recommendations for the Refuge System's place in bird conservation. It defines strategies for the Service, including the Refuge System, to actively support bird conservation through monitoring, conservation, consultation, and recreation. The refuge-specific HMP, to the extent it is practical, utilizes standard monitoring protocols, habitat assessment and management, and promotes nature-based recreation and education to forward the vision of the Migratory Bird Program Strategic Plan.

Service Birds of Conservation Concern (USFWS 2008b)

This report identifies the migratory and nonmigratory bird species (beyond those already designated as federally threatened or endangered) that represent the Service's highest conservation priorities and draws attention to species in need of conservation action. The geographic scope includes the U.S. in its entirety, including island "territories" in the Pacific and Caribbean. Bird species considered for inclusion on lists in this report include nongame birds, gamebirds without hunting seasons, subsistence-hunted nongame birds in Alaska, Endangered Species Act candidates, proposed endangered or threatened, and recently delisted species. Assessment scores are based on several factors, including population trends, threats, distribution, abundance, and area importance.

Wildlife Habitat in Pennsylvania, Past, Present, and Future (Goodrich et al. 2001)

Today, the PADCNR ranks coastal plain habitats as "impaired." The coastal plain region of Pennsylvania includes some of the last remaining habitats for certain wetland species in the State. The 2001 PADCNR report *Wildlife Habitat in Pennsylvania, Past, Present, and Future* (Goodrich et al. 2001), recommends that where possible, wetlands along the Delaware should be restored. Urban forest management is recommended to provide habitat for some tolerant forest wildlife. The reduction of runoff into streams and wetlands is also noted as a top priority, along with restoration of natural communities in undeveloped areas.

Bird Conservation Plan for the Mid-Atlantic Coastal Plain (Physiographic Area 44) (PIF 1999)

Partners in Flight is a partnership of government agencies, private organizations, academic researchers, and private industry throughout North America focused on coordinating voluntary bird conservation efforts to benefit species at risk and their habitats. BCRs have been developed to guide management on a regional scale. Version 1.0 of the Mid-Atlantic Coastal Plain BCR was completed in 1999. John Heinz NWR is located within the Coastal Plain physiographic province and thus is considering the conservation priorities of this plan along with other conservation plans.

Delaware Estuary Comprehensive Conservation Management Plan (DEP 1996)

The Delaware Estuary is faced with continuing threats from toxic substances, habitat loss and fragmentation, and human development. To help address these threats, the Delaware Estuary Program worked with many partners to develop the Comprehensive Conservation and Management Plan for the Delaware Estuary (DEP 1996). The Comprehensive Conservation and Management Plan is a comprehensive document describing the existing conditions of the Delaware Estuary and providing seven action plans (land management, water use management, habitat and living resources, toxics, education and involvement, and monitoring) and an implementation plan. While the Delaware Estuary Program has since merged with the Partnership for the Delaware Estuary, this reorganized entity is still active and is now responsible for addressing the various actions identified in the Comprehensive Conservation and Management Plan. We used this plan as a reference in developing habitat management and land protection planning objectives.

Refuge-specific Plans

In addition to these local, State, and regional plans, a number of other refuge program-specific plans have provided guidance either in their draft or final format, including but not limited to the following:

- Annual Habitat Work Plan (most recently completed in 2011, updated annually)
- Wildlife Disease Surveillance and Contingency Plan (completed 2006)
- Fire Management Plan (completed 2006)
- Public Use Plan (currently in draft form, to be completed in 2012)
- Law Enforcement Plan (currently in draft form, to be completed in 2012)
- Hurricane Action Plan (completed 2010)
- Energy Management Plan (completed 2003, updated annually)
- Safety Plan (completed 2010)
- Fishing Plan (to be completed within 3 years of CCP approval)

Chapter 2. Background

2.1 Refuge Location and Description

2.2 Geographical Setting

2.3 Historical Perspective

2.1 Refuge Location and Description

The 1,200-acre John Heinz NWR is one of the most urban refuges managed by the Service. It is located within the City of Philadelphia and neighboring Tinicum Township in Philadelphia and Delaware Counties, about one-half mile north of Philadelphia International Airport (map C.1). The freshwater tidal marsh at the refuge now comprises approximately 80 percent of the State's coastal wetland. The refuge represents an important migratory stopover along the Atlantic Flyway that provides a mix of freshwater habitats. It also provides protected breeding habitat for State-listed threatened and endangered species, as well as many neotropical migrants (Cohen and Johnson 2004).

The refuge contains a variety of ecosystems unique to Pennsylvania and the Philadelphia metropolitan area including tidal and nontidal fresh water marsh, freshwater tidal creek, open impoundment waters, coastal plain and riparian forests, and early successional grasslands. Many of the refuge's ecosystems have been degraded, damaged, or (in some cases) destroyed as a result of the numerous historic impacts. However, many of these impacted ecosystems have the potential to be restored or enhanced through various management efforts. Some areas, including portions of the tidal marsh, contain healthy and intact ecological communities. These areas will require a more protection and monitoring-focused approach. Due to the refuge's location within the coastal plain (a small and unique physiographic region within Pennsylvania), many of its ecosystems contain unique plant communities or species of conservation concern.

2.2 Geographical Setting

Bird Conservation Region and Partners in Flight Physiographic Area

The regional planning efforts completed by the North American Bird Conservation Initiative and PIF created a series of regional conservation planning units at a national scale. North American Bird Conservation Initiative efforts seek to unite all bird conservation efforts on a regional scale within Bird Conservation Regions (BCRs). PIF's planning focus is conservation of landbirds within biologically based regions identified as BCRs. BCRs are generally larger in scale than PIF Physiographic Areas.

John Heinz NWR is located within BCR 30 (Mid-Atlantic Coast) and PIF Physiographic Area 44 (Mid-Atlantic Coastal Plain; see map C.2). Priority habitats identified in BCR 30 that are present at John Heinz NWR include mud flat, estuaries and bays, estuarine emergent wetlands, freshwater emergent wetlands, forested wetlands, rivers and streams, forested uplands, and grasslands. The Mid-Atlantic Coast BCR extends across Coastal Plain regions from northern New Jersey down through Pennsylvania, Delaware, Maryland, and into Virginia. Threats to priority habitats within BCR 30 are largely associated with human impacts as a result of the region being highly populated, first by Native Americans, and then over 300 years of European colonization (USFWS 2008a).

Atlantic Coast Flyway

Flyways are important units for managing waterfowl and other migratory bird populations as they help connect management of breeding, migration, and overwintering areas. The partnership includes 18 states and commonwealths and key Federal and regional habitat conservation agencies and organizations in the joint venture area. It was originally formed as a regional partnership focused on the conservation of waterfowl and wetlands under the North American Waterfowl Management Plan in 1988. Since then the focus has broadened to the conservation of habitats for all birds consistent with major national and continental bird conservation plans and the North American Bird Conservation Initiative. John Heinz NWR is located in a unique landscape position along the Atlantic Coast Flyway. Its large open space and diverse habitats located along the Delaware River within a highly urbanized metropolitan area makes it a critical stop for many species.

Watershed Context

John Heinz NWR is located within the Delaware River Basin, which encompasses 13,600 square miles and stretches approximately 330 miles from headwaters in New York State to its confluence with the Atlantic

Ocean. The Delaware River watershed includes portions of Delaware, Maryland, New York, New Jersey, and Pennsylvania (DRBC 2004).

Within the Delaware watershed, the pre-industrial landscape was predominantly woods and wetlands, with expanses of farmland and nodes of human settlement. Decades of development and harvesting resulted in filled wetlands and a decrease in forests. By 1930, forests had been reduced to 32 percent and wetlands to 3 percent of the landscape. Between 1930 and 1996, urbanized land expanded from 3 to 14 percent (DRBC 2004).

Our project area (the refuge) is situated near the confluence of Darby Creek and the Delaware River located on the southwest boundary of the City of Philadelphia. Most of the 77 square miles of the Darby Creek watershed lies within Delaware County with additional portions found within surrounding Chester, Delaware, Montgomery, and Philadelphia Counties. The watershed is very urbanized, encompassing all (or parts) of 31 municipalities, which are home to approximately 500,000 people, with an average density of nearly 10 persons per acre (DCVA 2005).

Landscape Conservation Context

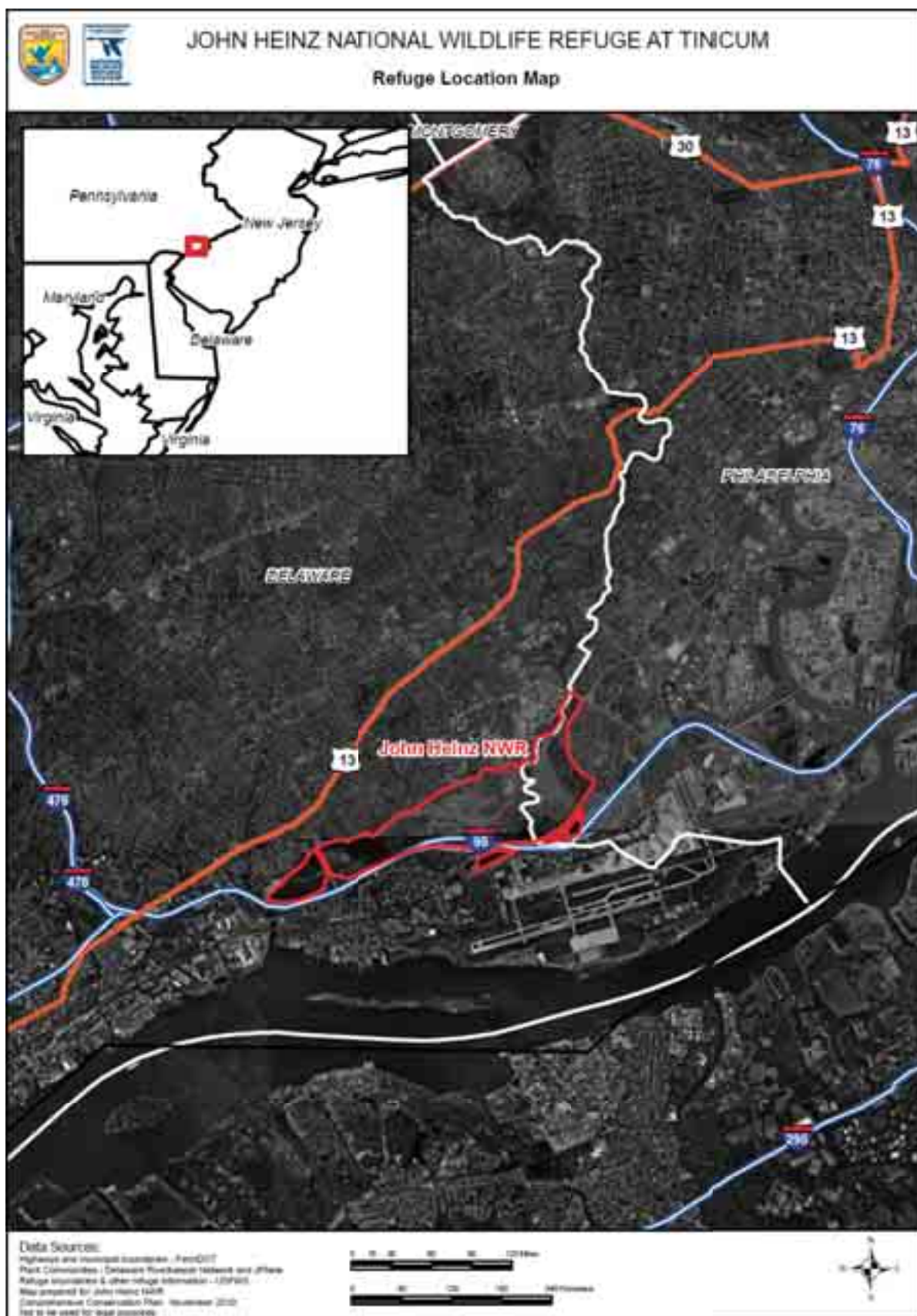
John Heinz NWR protects a variety of unique resources and also provides a unique opportunity for the education and outreach near the urban center of the City of Philadelphia, the nation's 5th largest metropolitan area (map C.1). Connecting children and families with nature is a very high priority national program of the Service. The urban interface of John Heinz NWR provides excellent opportunities for such environmental education and conservation outreach unlike any other refuge in the country. The ecosystems within John Heinz NWR, especially freshwater tidal marsh, support some of our nation's most biologically diverse assemblages of fish, wildlife, and plant species.

John Heinz NWR's location near the confluence of Darby Creek and the Delaware River also plays a significant role in the habitats and species utilizing the refuge. As one of only a few large freshwater marsh expanses along the Delaware River, the refuge provides an important stopover for many species during migration up the Delaware River flyway. The expanse of freshwater tidal marsh also provides critical spawning and nursery habitat for many riverine fish species.

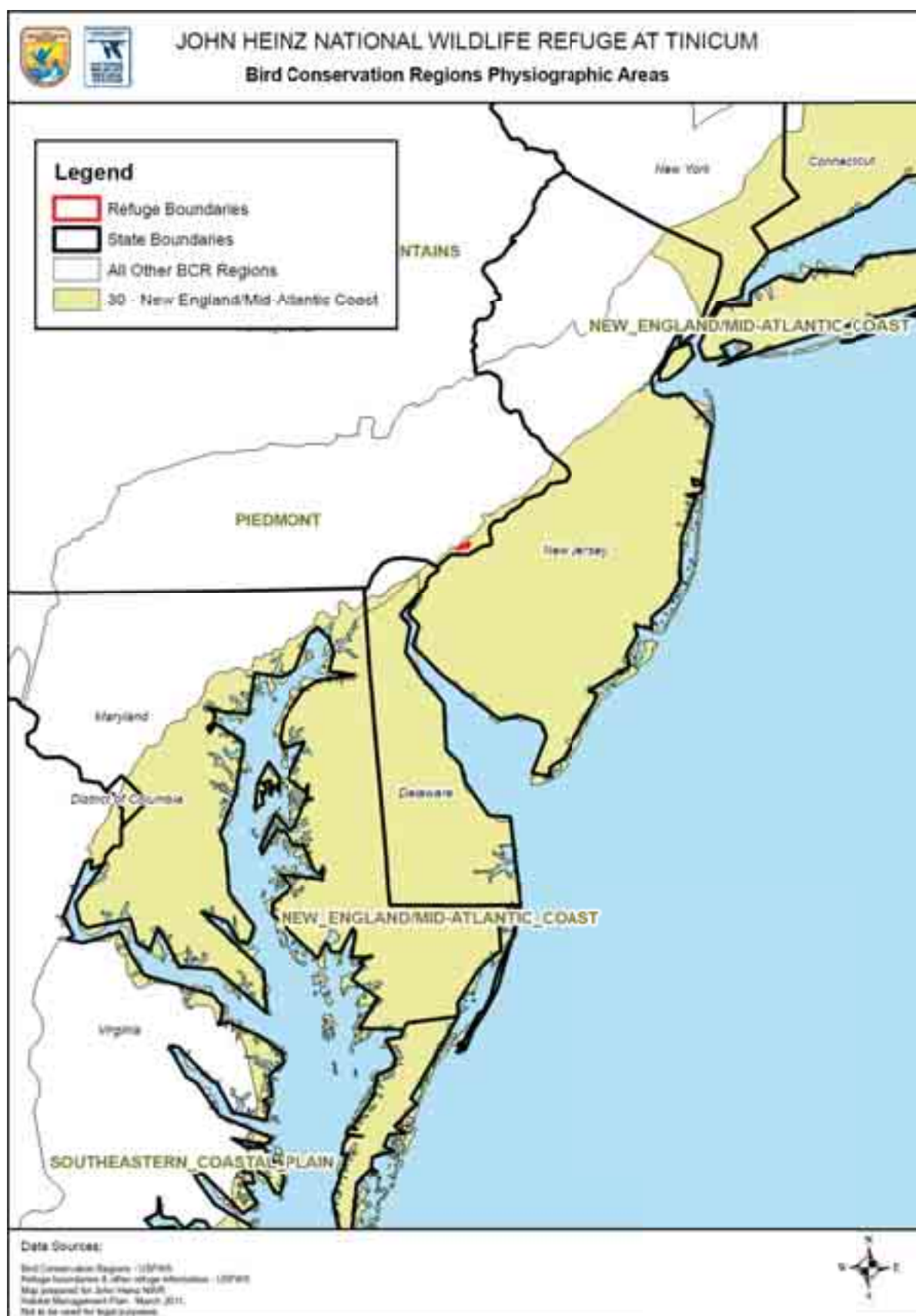
Much of the land surrounding the refuge is, and has been, urbanized for nearly 200 years. Major land use changes over the 20th century, however, brought major impacts to the refuge site and surrounding landscape like never seen before. Interstate highway, international airport, and expanded residential and industrial construction made John Heinz NWR a biological island contrasted amongst a highly urbanized landscape.

This position within a large urban area also provides many opportunities. More than 100,000 visitors from around the Delaware Valley and beyond visit the refuge each year. John Heinz NWR is in a unique position to foster greater community understanding of natural systems, species of conservation concern, the value of the refuge system, and the Service's mission in conserving and protecting those resources.

Map C.1. Location of John Heinz National Wildlife Refuge



Map C.2. Bird Conservation Regions in Relation to John Heinz National Wildlife Refuge



2.3 Historical Perspective

Geologic Development

John Heinz NWR is situated within Pennsylvania's southeastern most physiographic province, the Atlantic Coastal Plain (Low et al. 2002). This province extends from southern Delaware County up into Philadelphia County where it includes all of Philadelphia except the northwestern part. Outside of Pennsylvania, this province extends throughout areas along the Atlantic Ocean from Massachusetts to Florida, including all of southern New Jersey and most of Delaware.

This physiographic region is characteristically flat land with sandy soils. These soils are primarily composed of sand, silt, and gravel resulting from the weathering of very old Paleozoic and Precambrian metamorphic rocks. This rock, originally laid down as sediments 438 to 1,600 million years ago, was altered by heat and pressure to form various metamorphic rocks, which in turn weather relatively easily. These rocks can be further described by the minerals they are composed of, the specific process that formed them, and their physical characteristics.

The area is influenced by the Delaware River and is in a different group. It is composed of sand and gravel laid down by periodic flooding over the last 1.6 million years with additional silt and clay deposits where finer material was able to settle. Alluvial sediments in areas along this reach of the Delaware River were deposited over the last 12,000 years (PNHP 2008). These finer alluvial sediments are those which naturally comprise much of the soils throughout the refuge. PADCNr has highlighted Tinicum Marsh as an Outstanding Scenic Geological Feature worth noting within this physiographic province (DCNR 2010).

Pre-European Settlement

The pre-settlement forest of southeastern Pennsylvania was a mixed-aged forest (Latham et al. 2005). In areas along the Delaware River, the coastal plain forest type covered a significant portion of the Philadelphia area. This community supported a suite of species common further south. This community developed in this region because of the sandy soils combined with the warm coastal air blown up from Delaware Bay. This forest type was dominated by sweet-gum (*Liquidambar styraciflua*) and oaks (*Quercus spp.*) intermixed with species such as American beech (*Fagus grandifolia*). The understory would have also included broadleaved evergreen species such as American holly (*Ilex opaca*) (PNHP 2008).

Floodplain forests were also found along many river systems in this part of the State. These forests would have been regularly flooded, for various durations, on an annual basis. In the most frequently flooded areas, fast-growing species such as sycamore (*Platanus occidentalis*), silver maple (*Acer saccharinum*), and American and slippery elm (*Ulmus americana* and *U. rubra* respectively) would dominate. Associated species would include eastern cottonwood (*Populus deltoides*), common hackberry (*Celtis occidentalis*), black walnut (*Juglans nigra*), butternut (*Juglans cinerea*), green ash (*Fraxinus pennsylvanica*), and box-elder (*Acer negundo*) interspersed among them. Permanently wet or saturated areas, such as backwaters and isolated oxbows, would have supported swamp white oak (*Quercus bicolor*), pin oak (*Quercus palustris*), and red maple (*Acer rubrum*).

Grasslands and native meadows were likely to be found throughout the Philadelphia area prior to colonization. However, it is unlikely that these were self-maintaining systems. Meadows were often managed by resident Native Americans who burned them on a periodic basis to prevent their succession back to forest partly in order to provide forage for game species such as grouse, turkey, deer, and elk (Latham et al. 2005).

The Pennsylvania Natural Heritage Program estimates that Philadelphia County at one time contained up to 10 to 20 square miles (6,400 to 12,800 acres) of freshwater tidal marsh. Historically, and as it is today, these wetlands provided an important breeding spot for many bird, mammal, fish, amphibian, reptile, and insect species. It was also a critical stopover site for migratory waterfowl and shorebirds during their annual migrations. Today, John Heinz NWR protects the 1/3 square mile of freshwater tidal marsh that remains in this part of the State (PNHP 2008).

Human occupation of the lower Delaware River drainage likely began as early as 16,000 years ago with the arrival of the ancestors of the Lenni-Lenape people, known to the English as the Delawares. This reach of the river was narrower and nontidal at that time, flowing through forested floodplain and freshwater marshes. Sea level rise had already been initiated by melting of the Wisconsin ice mass far to the north, and continued at a gradually slowing pace until about 5,000 years ago, by which time the local environment had stabilized as a tidal estuary with marshes comprising not only most of the current refuge land, but also a large part of the area now covered by Philadelphia International Airport.

European Settlement

As a result of the destruction caused by intensive historic period development, remarkably few archaeological sites dating from prior to European contact have been found in Philadelphia or its surrounding boroughs. The earliest recorded sites within the city date from approximately 5,000 years ago, although it is likely that earlier ones existed and some may still exist in small and scattered areas of undeveloped land.

Within Tinicum Township, the landscape of the refuge consists entirely of tidal marsh with a system of artificial dikes. Some of the dikes are wide enough to support trees and brush on their edges, but close examination of early maps and photographs reveal no natural islands. The only refuge areas suitable for Native American occupation prior to European contact consist of two narrow strips of terrace on the north side of Darby Creek in the town of Folcroft and a larger area within the Eastwick portion, containing the refuge headquarters and maintenance areas. These areas were farmland in the early 20th century but are now wooded. These areas may retain some archaeological potential, though the immediate vicinity of the refuge headquarters consists of deep and remarkably extensive modern fill.

Soon after European settlement in the mid-17th century, farmers began to extensively dike and ditch tidal marsh to convert it to hayfields. Portions of the refuge dike system follow the trace of dikes dating from the mid-19th century, and likely considerably earlier. That earlier dike system was modified in the mid-20th century by installation of various water control structures, widening of virtually all dikes for construction of roads atop them, construction of interior dikes at some locations, and erosion of considerable lengths that fell out of use. The ditch system, poorly represented on historic maps but visible in early 20th century photographs, has almost completely vanished due to modern erosion and siltation. There are no standing historic structures on the refuge. The only dwelling sites recorded are two farmsteads established in the 1870s or earlier, both of which were obliterated by bridge construction and widening of South 84th Street in the 1970s.

20th Century Influences

Events that destroyed or highly altered what are now refuge lands over the 20th century are well documented in *Two Studies of Tinicum Marsh* (McCormick et al. 1970). One of the first impacts of the 20th century was the construction of the Philadelphia and Chester Railway Company, a trolley service that provided direct transit



Figure C.1. Historic Maps of Philadelphia Region (such as the example shown here) document the changes in land use and habitats around the refuge since European settlement (Scull 1752).

between Chester and Philadelphia from 1901 to November 1946 (Schieck and Cox 1970). This former trolley bed runs parallel to the refuge's southern access road. While the trolley bed is not within the refuge boundary, its construction impacted current refuge lands with extensive cut and fill operations along its corridor. Aerial photos of the refuge area from 1928 document the presence of extensive marsh as well as several dike and road systems (figure C.2). It continues to affect the hydrology and drainage in the area of the impoundment.

Figure C.2. Aerial photograph of John Heinz NWR lands in 1928 (prior to refuge establishment). Note the presence of extensive marsh and wetlands surrounded by agriculture.



The 1930s saw numerous, and expensive, repairs and alterations by the U.S. Army Corps of Engineers. The Federal Works Program Administration, Pennsylvania legislature, and Delaware County all appointed funds to repair the dikes along the southern edge of Darby Creek. In 1935, a proposal for mosquito control led U.S. Army Corps of Engineers to construct a series of ditches throughout Tinicum Marsh. Some of these artificial channels are still visible today in the northern half of the freshwater tidal marsh. From the 1930s until the 1950s, several areas within and around Tinicum Marsh were utilized by U.S. Army Corps of Engineers for landfills of dredged material (McCormick et al. 1970).

The early 1970s saw the construction of Interstate 95 (I-95) and an interchange system with State Road 420. These major changes resulted in the dredging and filling of many marsh areas around the refuge. Today, these areas remain as permanent open water features where dredging occurred and as either degraded floodplain forest or wetlands dominated by common reed (*Phragmites australis*).

The Folcroft Landfill operated from the 1950s through the 1970s accepting municipal, demolition, and hospital waste. It was closed in 1973 as a result of permit violations and improper management. Closing activities included regrading of the landfill, reducing steep slopes along with covering and seeding the site (USEPA 2006).

In 1980, Congress authorized the purchase of the Folcroft Landfill to increase the size of the refuge. At this time, the U.S. Environmental Protection Agency (USEPA) remains in discussion with potentially responsible parties regarding investigation of the landfill's contamination (USEPA 2006). The refuge will facilitate the

landfill cleanup efforts. In 1991, through a bill sponsored by Congressman Curt Weldon, the Tinicum Wildlife Preserve officially became John Heinz National Wildlife Refuge at Tinicum in honor of the late Senator who was influential in the marsh's preservation.

In February 2000, a subsurface pipeline owned by Sun pipe Company and operated by Sunoco, Inc. ruptured, releasing 191,982 gallons of crude oil into the 145-acre impoundment in the refuge. At the time of the release, the impoundment contained a thick layer of ice that formed a natural barrier which prevented the oil from spreading throughout the impoundment. At its peak, the area affected by the oil spill encompassed approximately 1.6 acres. This included the oil slick floating under the ice and an area of shoreline adjacent to the slick containing emergent, scrub-shrub, and forested wetlands. Sunoco provided initial response personnel to secure the site and to begin the initial cleanup operation. More than 90 percent (173,799 gallons) of the spilled oil was recovered through the cleanup effort. In addition to the 1.6 acres directly impacted by oil contamination, another 1.25 acres were directly impacted by response vehicles and equipment.

Shortly after the oil leak was discovered and concurrent with the initial cleanup efforts, the Service, the PFBC, and the PADEP initiated a cooperative Natural Resource Damage Assessment. Subsequently, the USEPA, Region III issued a Unilateral Administrative Order for the Abatement of Endangerment that required "restoring all areas, including soils and sediments, to the maximum extent possible, to their condition before the discharge of oil." Sunoco and the participating agencies developed a restoration plan. Restoration efforts were completed and a final report was submitted to the USEPA on June 3, 2005 (Entrix, Inc. 2005).

Habitat loss and degradation is the single greatest cause of loss or decline of species across the globe (and in Pennsylvania), threatening over 80 percent of rare and endangered species (Wilcove et al. 1998). Exotic, invasive species that compete with or reduce populations of native species is the second greatest cause of declines (affecting over 50 percent of terrestrial species). In Pennsylvania, an estimated one-third of all plants are nonnative, and 11 percent of all fish are exotics (Goodrich et al. 2001).

Maps of the refuge area dating back to the late 1700s show an area largely comprised of wetlands—likely freshwater tidal marsh, as it was historically present along the Delaware River. Over the following two centuries, agriculture and urbanization slowly encroached on these wetland areas. John Heinz NWR today is largely an island of habitat within its urban surroundings. As a result, large predators and other species that would have once inhabited the area are now gone.

PADCNR compiled an overall habitat quality rank by using estimates of habitat quality for streams, wetlands, forests, and grasslands index for each physiographic region throughout the State. This ranking highlights coastal plain habitats as the only "impaired" habitats within the State of Pennsylvania and highlights the coastal plain region as being home to some of the last remaining habitats for certain wetland species in the State. PADCNR recommends that where possible, wetlands along the Delaware should be restored (Goodrich et al. 2001). Urban forests could be focal points to provide habitat for some tolerant forest wildlife. Reduction of runoff into streams and wetlands should be top priority, along with restoration of natural communities in undeveloped areas (Goodrich et al. 2001).

The Refuge, the Land, and the People

The cultural history of the region reflects changing societal values in the U.S.. The Lenape and earlier indigenous people, along with European explorers and settlers, valued the marshes and adjacent uplands for agriculture, fishing, and hunting along with its strategic location for trade and transportation. Undoubtedly, this area's ongoing relationship with different cultures and land ethics throughout the centuries has had many impacts on the refuge as it is known today.

As the Tinicum region developed, the perceived value of marshes diminished for the public, which resulted in the fill or dredging of many acres of wetlands. The history of the refuge over the past 50 years reflects a renewed and refined sense of ecological value in respect to habitat protection and conservation.

2.4 Climate Influences and Natural and Anthropogenic Disturbances

The coastal climate of the Mid-Atlantic is characterized by seasonal variations from hot and humid summers to cold winters. The average summer temperature is around 75° Fahrenheit (F), while the average winter temperature is 33°F. Average precipitation totals around 46 inches per year, with an average annual snowfall of around 30 inches (NCDC 2006). July tends to be the warmest and wettest month with an average temperature around 85°F and average monthly rainfall around 4.38 inches. Along with the moderating effects of the coastal climate, hurricanes, tropical storms, and Nor'easters can provide extreme precipitation events (NCDC 2006). In recent years, these large events have caused flooding in and around the refuge.

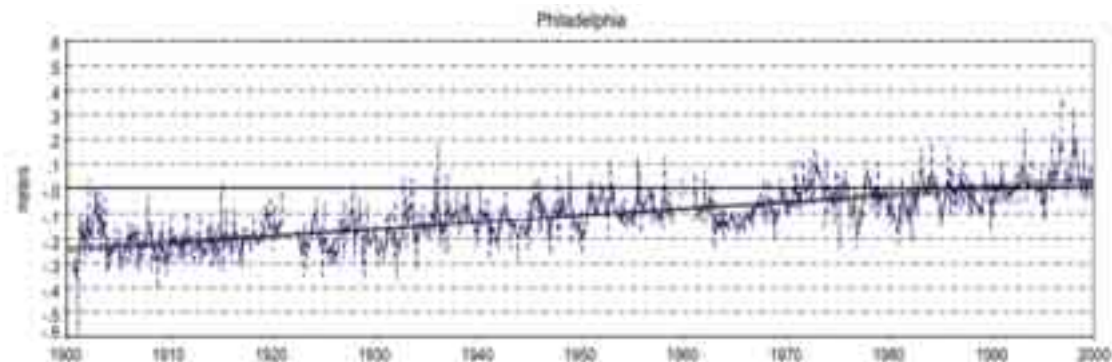
2.5 Current Refuge Conditions

Climate

The coastal climate of the Mid-Atlantic is characterized by seasonal variations from hot and humid summers to cold winters. Along with the moderating effects of the coastal climate, hurricanes, tropical storms, and Nor'easters can provide extreme precipitation events. In recent years, these large events have caused flooding in and around John Heinz NWR.

Like many areas throughout the world, the climate of southeastern Pennsylvania is changing. Over the past century a rise in mean annual temperature of 0.5°F has been recorded. Sea level, as measured by a tidal gauge at Philadelphia, has also risen nearly 1 foot over the past century as shown in figure C.3.

Figure C.3. Monitored sea levels at Philadelphia (1900–2000) displaying nearly a 1-foot rise in sea level over the past century (NOAA/NOS 1999).



Climate change and sea level rise projections for the region will potentially have major influences over the refuge's habitats and their management over the coming decades. The precise ecological impacts to the refuge as a result of a changing climate are largely unknown at this time. Detailed monitoring of habitat conditions and species utilization will be necessary to identify potential shifts in species assemblages or distribution across the refuge and region. However, reports and guidance documents published in recent years provide projections and estimates upon which the refuge can begin to build an understanding of how these potential impacts may manifest themselves and impact the refuge.

According to a recent report released by the Union of Concerned Scientists, temperature projections for the coming decades (2010 to 2039) may make eastern Pennsylvania's climate more closely resemble that of Maryland or northern Virginia as we know it today (UCS 2008). Philadelphia and other large cities already experience extreme heat and air pollution events. The Intergovernmental Panel on Climate Change (IPCC) projects that urban areas throughout North America will experience more severe and longer heat waves

and increased impacts from air pollution (UCS 2008; Philadelphia AMS 2008). In their *Summary Report for Policymakers*, the IPCC warns with “very high confidence” that these extreme temperature events may lead to increasing impacts on forests through disturbances from pests, diseases, and extended periods of high risks of fire. It is important to note that “very high confidence” is defined as a 9 in 10 likelihood of occurrence (IPCC 2007).

Recent sea level rise estimates by the IPCC for global sea level rise could have serious implications for the freshwater tidal marsh within John Heinz NWR. Conservative estimates project a rise between 7 and 14 inches over the next century, while higher estimates range between 10 and 23 inches (UCS 2008). Estimates by Najjar et al. (2000), project global sea level rise between 0.4 to 1.2 inches by 2030 and between 1.6 to 4.0 inches by 2095. Recent estimates compiled by the Climate Adaptation Working Group as part of the Partnership for the Delaware Estuary’s report *Climate Change and the Delaware Estuary* (Najjar et al. 2010) indicate relative sea level rise (which accounts for mean sea level rise and land subsidence) may increase 2.6 to 5.6 feet (0.8 to 1.7 meters) by the end of the century.

Sea levels have fluctuated over many millennia. Tidal marshes (both salt and freshwater) typically respond to these fluctuations through two mechanisms: accretion of sediment across the marsh surface (e.g., a rising of the marsh surface elevation) or expansion into nearby (and topographically higher) riparian lands (e.g., conversion of surrounding lands) (Odum et al. 1984). Given the urbanization of the Darby Creek watershed and lands immediately surrounding the refuge, it is unclear which, if either, of these options may allow the necessary adjustment to rising sea levels.

In addition to the rise in water levels alone, the salt line of the Delaware River¹ has potential to shift upstream and into the zone encompassing the refuge. Currently, the refuge is less than 1 mile upstream from the salt line. The intrusion of salt water is problematic for freshwater tidal marshes and freshwater tidal swamps that cannot tolerate salinities greater than 0.5 milligrams per liter. Not only plants, but animal and microbial communities will be altered by salt intrusion (Weston et al. 2006, Craft 2007). As plants with a low salt tolerance become stressed, less productive and die, marsh communities shift to salt-tolerant species.

A major shift in the salinity of waters within the refuge could lead to a major shift in plant communities and species within areas containing freshwater tidal marsh today. Neither the effects of sea level rise on marsh elevations nor salinity levels are well understood within the Delaware Bay at this time, although preliminary analysis shows that the estuary has increased in salinity over time (Kreeger et al. 2010). Monitoring these influences over the coming years will be a major step in developing management options for the refuge in years to come.

In an effort to address the potential effects of sea level rise on U.S. national wildlife refuges, the Service contracted the application of the Sea Level Affecting Marshes Model (SLAMM) for most refuges in the Service’s Northeast Region. This analysis was initiated to inform the decisionmaking process as part of CCP development for each refuge along with other long-term management plans. Changes in tidal marsh area and habitat type in response to sea level rise were modeled using the SLAMM 6.0. This model accounts for the dominant processes involved in wetland conversion and shoreline modifications during long-term sea level rise (Park et al. 1989) (<http://www.warrenpinnacle.com/prof/SLAMM>; accessed January 2012).

For John Heinz NWR’s analysis, SLAMM 6.0 was run using scenario A1B from the Special Report on Emissions Scenarios – mean and maximum estimates (Warren Pinnacle Consulting, 2010). The A1 scenario assumes that the future includes very rapid economic growth, global population that peaks in mid-century and declines thereafter, and the rapid introduction of new and more efficient technologies. Under the A1B scenario, the IPCC WGI Fourth Assessment Report (IPCC 2007) suggests a likely range of 0.7 to 1.6 feet (0.21 to 0.48 meters) of sea level rise by 2090 to 2099 “excluding future rapid dynamical changes in ice flow.” The A1B-mean scenario that was run as a part of the refuge-specific analysis falls near the middle of this estimated range,

¹ This is the zone where low-salinity freshwaters from the Delaware River watershed combine with high-salinity waters from Delaware Bay (characterized as having a concentration of 250 milligrams per liter (mg/L) sodium chloride).

predicting 1.3 feet (0.40 meters) of global sea level rise by 2100. To allow for further analysis, SLAMM was also run assuming 1 meter, 1½ meters, and 2 meters of global sea level rise by the year 2100.

According to the SLAMM analysis conducted, John Heinz NWR is predicted to experience significant effects of sea level rise (Warren Pinnacle Consulting 2010). Undeveloped dry land, which makes up roughly one quarter of the refuge, is predicted to be lost at a rate between 24 percent and 54 percent (66 to 145 acres respectively) across the range of sea level rise scenarios. Tidal fresh marsh, which makes up roughly one third of the refuge, is predicted by to be lost at a rate of 9 percent to 84 percent (14 to 352 acres, respectively) once scenarios exceed 0.39 meters of global sea level rise (Warren Pinnacle Consulting 2010). According to these results, the refuge will begin to see the most drastic effects of sea level rise, once it exceeds 0.69 meters. These shifts in habitat type would result in major shifts in the habitat types and species composition across the refuge.

Another concern related to sea level rise is increasing salinity. Increasing sea levels will result in larger tidal volumes that carry more salt water higher up into the estuary. Sea level rise could increase the tidal range in the Delaware system (Walters 1992). Tidal range changes would also likely increase the salinity range over the tidal cycle (Kreeger et al. 2010). A preliminary analysis, completed by Najjar (2010), reviewed existing salinity measurements dating back to 1927 to document trends in salinity within the Delaware Estuary. His results suggest that salinity is increasing at a rate greater than can be explained by streamflow and models of the response of salinity to sea level. This phenomenon could be a result of other forces in the estuary, such as successive channel deepening events that occurred during the period of analysis, which could have also contributed to salinity intrusion due to larger tidal volumes and bathymetric changes (Kreeger et al. 2010). Due to such complexities involved in determining salinity migration at the upper end of the estuary, modeling of potential changes in salinity resulting from sea level rise could not be completed at the time of this writing.

Again, the IPCC warns with “high confidence” (or an 8 in 10 chance) that, “the resilience of many ecosystems is likely to be exceeded this century by an unprecedented combination of climate change, associated disturbances (e.g. flooding, drought, wildfire, insects, ocean acidification) and other global change drivers...” (IPCC 2007). Heavy rain and snow events are anticipated for many parts of North America. For John Heinz NWR, being at the base of the Darby Creek watershed, already highly urbanized and experiencing frequent flooding, this prediction will only lead to more frequent flood events over the coming decades.

Over the last century, the annual average temperature in Pennsylvania increased by over 0.5°F (UCS 2008; NOAA 2008). This warming has resulted in many climate-related changes such as more frequent days with temperatures above 90°F, a longer growing season, increased heavy precipitation events, less winter precipitation in the form of snow and more as rain, and rising sea surface temperatures and sea level (Hayhoe et al. 2007).

Being located in a physiographic region where the ranges of many species overlap between northern and southern regions, the piedmont and coastal plain, plant, fish, and animal populations are diverse. These shifts in temperature and precipitation will likely impact the plant and animal populations adapted to the historic climate of the Mid-Atlantic. As summers are projected to become warmer across the Northeast, many plant species are likely to shift ranges northward (Iverson et al. 2008).

As outlined in earlier chapters, the refuge has acted as an ecological oasis within the highly urbanized lands surrounding Philadelphia. It has provided refuge for many species that use its habitats for migratory stopovers, nesting, spawning, and feeding. Habitat fragmentation has long been associated with reductions in habitat quality and resilience. This aspect of the refuge and its habitats will undoubtedly play a role in how they respond to a changing climate.

Hydrology and Geomorphology

John Heinz NWR is located at or slightly above sea level. Consequently, Darby Creek and the freshwater tidal marsh within the refuge contain a daily tidal fluctuation of around 6 feet. Darby Creek flows through the refuge just upstream from its confluence with the Delaware River. Collectively, the Darby Creek and Cobbs Creek (a

major tributary of Darby Creek) watersheds drain approximately 74.1 square miles by the time they reach the refuge (USGS 2009).

As part of the *Restoration Management Plan for the Lower Darby Creek* (Salas et al. 2006), baseline geomorphic stream data was collected and analyzed for trends erosion and sinuosity from historic (1965 to 1990) and more recent (2000) aerial photographs along with topographic and other maps displaying the refuge area dating between (1757 and 2004). Darby Creek throughout much of the refuge is characterized by a braided stream channel with variable sinuosity. This channel type is common in coastal tidal streams near river deltas and tends to be a relatively stable channel. However, major changes to the stream or watershed such as loss of vegetation, channel alterations, and urbanization, can affect stream morphology and cause the stream channel to adjust significantly (e.g., cause erosion and deposition) (Salas et al. 2006).

The basic geomorphic assessment of Darby Creek and other tributaries within the refuge generally reflect this inherent stability and response to major impacts. The majority of streams within the refuge have remained relatively stable over the past 40 years and longer. Analysis of historic aerial photographs and other maps show Hermesprotta and Little Thoroughfare Creeks and portions of Darby Creek appearing relatively unchanged. However, major changes have been noted on Bow Creek and on other portions of Darby Creek.

Bow Creek, which historically connected Darby Creek and the Delaware River across what is now Philadelphia International Airport, is today completely isolated from Darby Creek. Darby Creek itself has displayed several signs of adjustment, most notably during the 1980s. Analysis of aerial photos from 1980 and 1990 show that the multi-channeled Darby's main channel cut through the center of Tinicum Marsh, shortening its total length by nearly half (from 8,400 linear feet to 4,800 linear feet). It is unclear what influenced this dramatic shift or whether the blockage of Bow Creek may have influenced this alteration of Darby Creek. The channel has remained relatively unchanged since this last adjustment period.

Many of the areas in and around the refuge were historically freshwater tidal marsh. As discussed previously, loss and alteration of wetlands dates back centuries, as early as the first Dutch settlements of the 1640s, when many marsh areas around the Tinicum region were diked for agriculture. More recent losses of tidal marsh occurred between the 1950s and early 1970s, when several areas of the refuge were filled or dredged. As a result of these large-scale disturbances, altered hydrology, invasive species introductions, and high levels of deer browse continually impact many of the natural communities within the refuge. As observed as part of the Delaware Riverkeeper Network's field surveys conducted in 2005, these areas are typically dominated by near monocultures of nonnative invasive species, contain fill and debris, un-natural amounts of open water habitat, and lack proper ecosystem structure (Salas et al. 2006).

The refuge also contains a 145-acre open water impoundment. For most visitors to the refuge, the impoundment is the focal point of their visit. Historically, the impoundment was managed as open water with periodic tidal fluctuation. In recent years, the Service has managed the water levels within the impoundment to benefit migratory waterfowl and shorebirds. This periodic drawing down of the impoundment and the presence of mud flats provide some of the best stopover habitat for migrating shorebirds in Pennsylvania. The area also serves as a wintering ground for over 20 species of waterfowl by providing stopover habitat for 1,100 to 1,400 individuals per day between September and March (Green et al. 2008).

Soils

The Soil Survey of Philadelphia County shows the lands of the refuge being comprised of marsh soils and urban land (e.g., organic and mixed fill) (NRCS 2009). As discussed in previous sections, the natural soil composition of most, if not all, of the refuge lands consisted of silty alluvial soils deposited over the last 12,000 years. However, significant soil disturbances that occurred during the 20th century altered the soil structure (and consequently the hydrology) of many areas in and around the refuge. Thus, most upland areas within the refuge are comprised of organic fill material. Despite this significant impact, many of the riparian forest communities that naturally occur within this region (coastal plain and floodplain forests) seemed to have established in many of these areas.

Water Pollution

The refuge is located within highly urbanized and industrial surroundings, making it vulnerable to many factors that could negatively affect ecosystem and wildlife health. Point source and nonpoint source pollution within the Darby Creek watershed and Delaware Estuary affects water quality and available food chain support for ecosystems providing habitat at the refuge.

Water quality in the refuge is the result of the inputs to three major streams: Darby Creek, Cobbs Creek (a major tributary to the Darby), and the Delaware River. For management purposes, the tidal portions of Delaware River tributaries are considered to be part of the river. Twice each day, river water enters the Darby system during high tide. In addition, various fish species freely move between Darby Creek and the Delaware River. Because of these factors, the tidal portion of Darby Creek is considered part of the Delaware River Basin Commission's Interstate Pollution Control Zone 4 (DRBC 2004). A zone-by-zone assessment of the attainment of designated water quality uses by the Delaware River Basin Commission indicated that Zone 4 attained its recreational designated uses, but not its aquatic life uses (DRBC 2004). The contribution from each of these sources varies depending upon hydrologic, climatologic and anthropogenic conditions. Thus, the water quality found in the refuge is highly variable and complex. The status of water quality and aquatic life is determined by various chemical, physical and biological parameters.

Data for Darby and Cobbs Creeks have been collected by the Pennsylvania Department of Environmental Protection (PADEP), the U.S. Geological Survey (USGS), the Philadelphia Water Department (PWD), Darby Creek Valley Association, the Academy of Natural Sciences, and others. Long-term monitoring of the tidal Delaware River occurs through the Delaware River Basin Commission with the Delaware Department of Natural Resources and Environmental Conservation conducting the sampling via contract from Delaware River Basin Commission. The refuge is fortunate that a number of reports have been produced that describe the status of the Darby Creek watershed based on recent data: the Darby Creek Rivers Conservation Plan (DCVA 2005), Lower Darby Creek Area 33 USEPA Facility Report (NOAA 2000), and PWD's Darby-Cobbs Characterization Report (PWD 2002).

During the early 20th century, the Delaware River in the vicinity of Philadelphia and Camden was the most polluted stretch of river in the U.S., if not the world (Albert 1988). In September 1946, no dissolved oxygen was found in this reach of the river; a "dead zone" that extended for a distance of more than 20 miles. In the intervening years, a massive effort was made to clean up the Delaware Estuary. By the mid-1980s, major reductions in nutrient pollution resulted in needed water quality improvements. The reach where Darby Creek enters the Delaware has shown substantial improvement in this regard.

Fish data collected in recent years indicate that Darby Creek has greater species diversity including some pollution intolerant species. Biometric scores suggest that the downstream reach of Darby Creek is "good," although upstream locations were "fair" or "poor" (PWD 2002). Cobbs Creek fish metrics indicate only "fair" or "poor" (PWD 2002).

Environmental Contaminants

Environmental contaminants have a major impact on the health and fitness of wildlife present on the refuge. The Folcroft Landfill, which became part of the refuge in 1980, is part of the Lower Darby Creek Area Superfund Site. The Lower Darby Creek Area includes four other sites within a 2-mile stretch along Darby Creek (NOAA 2000). Of the five sites, only Folcroft Landfill is located on the refuge. Coordination with the USEPA regarding contaminant remediation is ongoing. Ultimately, the Service will likely take the lead on completing restoration activities on this site.

Over the years, there have been widespread fish advisories in the river and various tidal tributaries, not including Darby Creek. These advisories are the result of contaminants found in fish, including polychlorinated biphenyls. In 2003, Service staff collected 31 brown bullheads (*Ameiurus nebulosus*) as part of a habitat assessment related to Folcroft and Clearview Landfills with the main objective being to determine the prevalence of liver and skin tumors, preneoplastic lesions, and barbel abnormalities. Their findings reported a 26 percent prevalence of liver tumors and a 6 percent prevalence of skin tumors in brown bullheads (less than 260 mm in length) from Lower Darby Creek. Liver tumor prevalence is indicative of a contaminated habitat. Levels found were more than five times the Baumann (2002) criteria for distinguishing highly contaminated Areas of Concern from less contaminated Areas of Recovery (Pinkney et al. 2004).

A large crude oil spill in 2000 located on the refuge impacted the reproduction of resident turtle populations. Research was conducted to determine the effect of crude oil exposure on female snapping turtle and painted turtle fertility, reproductive output, and development of offspring (Bell 2005). There was no significant difference in egg fertility between female snapping turtles exposed to oil or control turtles. However, female snapping turtles had significantly lower fertility of eggs in 2002 compared to 2000. There was no difference in reproductive output between exposure groups or years for snapping turtles or painted turtles. Most snapping turtle embryos died early in development, and there were significantly more early deaths for oil exposed snapping turtles than controls. Control painted turtles not only had a higher incidence of abnormality than control snapping turtles, but malformations were more severe in the former than the latter. Oil exposure exacerbated developmental problems in snapping turtles, causing increased incidence and severity of deformity in embryos.

The study noted that both species exhibit high rates of embryonic and adult deformity and that although the refuge offers many advantages to the resident turtle populations, background pollution places a developmental burden on the life history of turtles that was exacerbated by exposure to crude oil. Despite the deformities documented in both oil-exposed and control turtles, exposure to crude oil did not appear to have significantly affected the fertility or relative clutch size of snapping turtles or painted turtles (Bell 2005).

Natural Community Types

Refuge lands include a variety of ecosystems including open water, forests, grasslands, and tidal and nontidal wetlands. Many of the ecosystems (and the habitats they support) have been degraded, damaged, or destroyed as a result of the numerous impacts previously cited. Despite these alterations, many of these impacted ecosystems have the potential to be restored through various management actions and specific projects. Other areas, including portions of the freshwater tidal marsh, contain healthy and intact plant communities that will require a more protection-focused approach to management. Some ecosystems support plant communities or species of concern.

The Refuge System adopted the National Vegetation Classification System (NVCS) developed by the Nature Conservancy and the Natural Heritage Network as a standard for classifying plant communities. The classification contains hierarchical levels of community specificity. The narrowest level within the classification is the Association. The Restoration Management Plan for the Lower Darby Creek (Salas et al. 2006) included an inventory of the plant communities present at John Heinz NWR. Table C.1 lists the NVCS Associations found within the various broad-scale habitats of the refuge. Some communities were identified only down to the Alliance level, which is a broader category above Associations. Where possible, the conservation status rankings have been indicated as referenced by NatureServe Explorer and the Pennsylvania Natural Heritage Program. Conservation status rankings indicate the degree of imperilment of a species or community on either a global, national, or State level. The location and extent of these plant communities is displayed on map C.3.

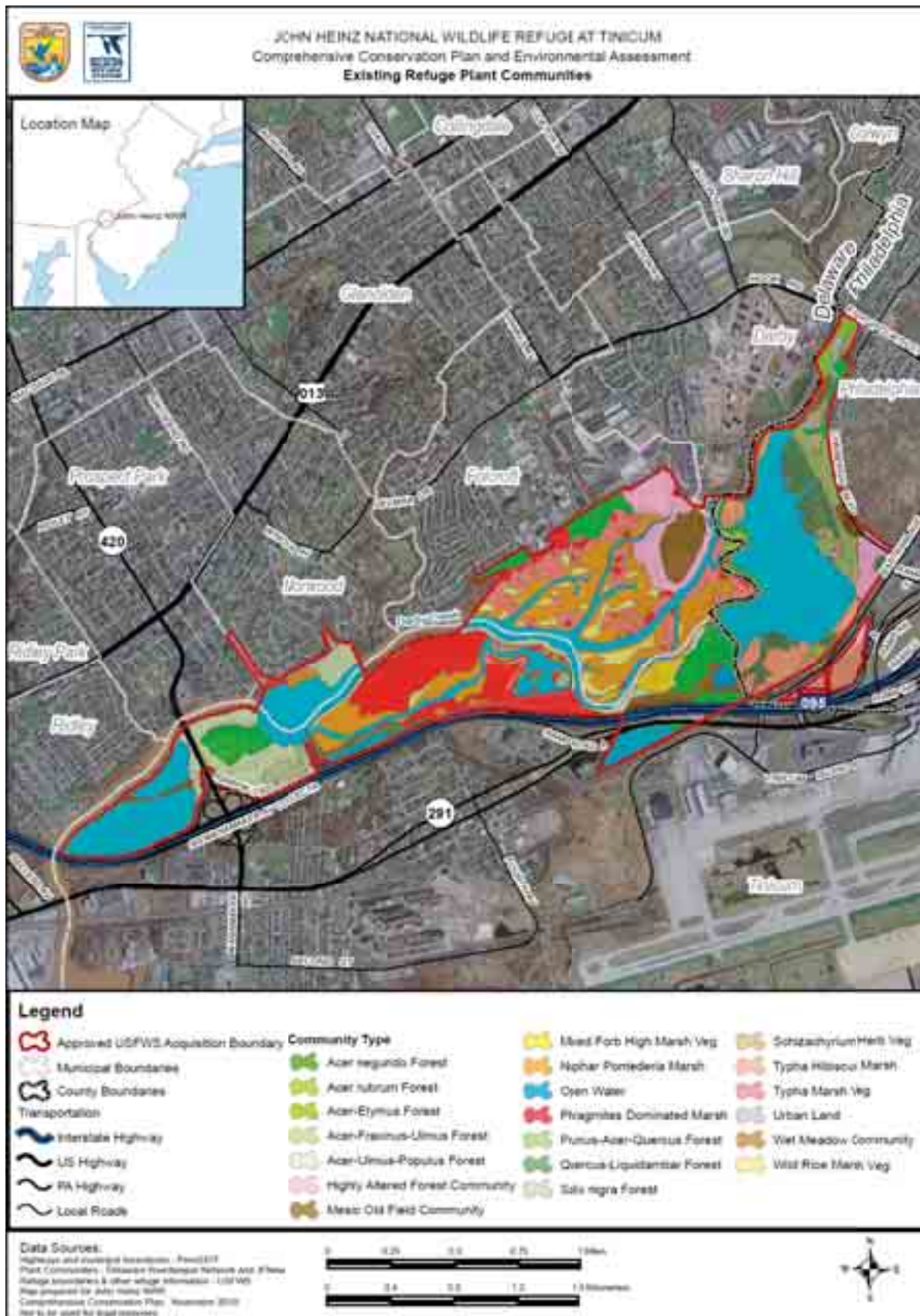
Table C.1. Broad Habitat Types and National Vegetation Classification System Associations and Alliances Found Within John Heinz NWR Based on the National Vegetation Classification System.

Broad Habitat Types	Natural Community Types (Association or Alliance)	Conservation Ranking (Global¹; State²)
<i>Freshwater Tidal Marsh</i>	<i>Atlantic Coast Wild Rice Tidal Marsh</i>	G4; S1
	<i>Freshwater Intertidal Mudflat</i>	G3/G4; S1
	<i>Freshwater Tidal Mixed Forbs High Marsh</i>	GNR; S1
	<i>Nuphar lutea Tidal Marsh</i>	GNR; SNR
	<i>Peltandra virginica - Pontederia cordata Tidal Herbaceous Vegetation</i>	G3/G4; S1
	<i>Phragmites Dominated Marsh</i>	GNR; SNR
	<i>Typha (angustifolia, latifolia) - (Schoenoplectus spp.) Eastern Herbaceous Vegetation</i>	G5; SNR
<i>Freshwater Nontidal Wetlands</i>	<i>Phragmites Dominated Marsh</i>	GNR; SNR
	<i>Typha angustifolia - Hibiscus moscheutos Herbaceous Vegetation</i>	GNR; SNR
<i>Open Water</i>	<i>Freshwater Intertidal Mudflat</i>	G3; S1
<i>Coastal Plain Forest</i>	<i>Quercus palustris - Quercus bicolor - (Liquidambar styraciflua) Mixed Hardwood Forest</i>	G3; S2
<i>Floodplain Forest</i>	<i>Acer negundo Forest</i>	GNR; SNR
	<i>Acer rubrum Forest</i>	GNR; SNR
	<i>Acer saccharinum - Acer negundo / (Elymus virginicus) Forest</i>	G4; SNR
	<i>Acer (rubrum, saccharinum) - Fraxinus spp. - Ulmus americana Forest</i>	G4; S1
	<i>Acer saccharinum - Ulmus americana - (Populus deltoides) Forest</i>	G4; S3
	<i>Salix nigra Temporarily Flooded Shrubland</i>	GNR; SNR
	<i>Prunus serotina - Acer rubrum - Amelanchier canadensis - Quercus spp. Forest Alliance</i>	GNR; SNR

¹ NatureServe Global Conservation Status Rankings: G1=Critically Imperiled; G2=Imperiled; G3=Vulnerable; G4=Apparently Secure; G5=Secure; GNR=Not Ranked; GU=Unknown; GX=Presumed Extinct; GH=Possibly Extinct

² NatureServe State Conservation Status Rankings: S1=Critically Imperiled; S2=Imperiled; S3=Vulnerable; S4=Apparently Secure; S5=Secure; SNR=Not Ranked; SU=Unknown; SX=Presumed Extinct; SH=Possibly Extinct; SNA=Not Applicable

Map C.3. Plant Communities of John Heinz National Wildlife Refuge



Rare Plant Species and Exemplary Natural Communities

John Heinz NWR protects the last significant remnant of freshwater tidal marsh within the State of Pennsylvania. Several of the natural communities within the freshwater tidal marsh are ranked as S1 - critically imperiled within the State (typically 5 or fewer occurrences or very few remaining individuals or acres), or S3 - vulnerable in the State either because they are rare and uncommon, or found only in a restricted range, or because of other factors making them vulnerable to extirpation (typically 21 to 100 occurrences). The forested habitats of the refuge also contain communities of significant conservation status. Several coastal plain and floodplain forest communities identified on the refuge are ranked as S1 (critically imperiled), S2 (imperiled), or S3 (vulnerable).

Many of the plant species associated with the freshwater tidal marsh are also unique to Pennsylvania. Pennsylvania DCNR notes that portions of the freshwater tidal marsh support several State rare species such as waterhemp ragweed (*Amaranthus cannabinus*), field dodder (*Cuscuta pentagona*), Walter's barnyard-grass (*Echinochloa walteri*), an unnamed eupatorium (*Eupatorium rotundifolium*), forked rush (*Juncus dichotomus*), and shrubby camphor-weed (*Pluchea odorata*) (VanDervort-Sneed personal communication 2010).

Wildlife

John Heinz NWR was established in 1972 for the purpose of preserving, restoring, and developing the natural area known as Tinicum Marsh, to promote environmental education, and to afford visitors an opportunity to study wildlife in its natural habitat. The refuge is an important migratory stopover along the Atlantic Flyway. The diverse habitats support a variety of resident and migratory wildlife including 300 species of birds recorded since 1950, as well as many mammals, fish, amphibians, reptiles, insects, and plants. Refer to appendix A for the refuge's comprehensive list of species of conservation concern.

Birds

The refuge is a complex of critical habitats for birds in the highly urbanized landscape of greater Philadelphia. It has been designated as an Important Bird Area by the National Audubon Society. While most of the over 300 bird species identified at the refuge use it as a migratory stopover, more than 80 species have been recorded nesting on the refuge over the years. Several species are also State-listed threatened or endangered species or species of State or national management concern.

State endangered species such as the least bittern (*Ixobrychus exilis*) are known to breed at the refuge. Other Pennsylvania endangered species that have been observed at the site during migration, but are considered occasional or rare in abundance, include: yellow-crowned night-heron (*Nyctanassa violacea*), common tern (*Sterna hirundo*), black tern (*Chlidonias niger*), king rail (*Rallus elegans*), short-eared owl (*Asio flammeus*) and loggerhead shrike (*Lanius ludovicianus*). The king rail historically nested at the site (prior to 2000). The piping plover (*Charadrius melodus*) listed as extirpated in Pennsylvania, is an occasional "accidental" occurrence during migration.

Bald eagles (*Haliaeetus leucocephalus*), a former federally listed species, have historically used the refuge for hunting and roosting. The first known bald eagle nest on the refuge was built in 2009 with the first two refuge eaglets successfully hatched in 2010. The adult pair returned to breed on the refuge in 2011.

The peregrine falcon (*Falco peregrinus*), another former federally listed species, is often observed from the refuge during its migration. A number of active peregrine nests now occur in the Philadelphia area with these birds also potentially increasing their use of refuge habitats (Cohen and Johnson 2004).

The State-listed, threatened species, upland sandpiper (*Bartramia longicauda*) and yellow-bellied flycatcher (*Empidonax flaviventris*), have been observed at the site, but are considered rare or occasional in abundance, observed primarily during the migratory season. Ospreys (*Pandion haliaetus*) are present during migration and are frequently observed throughout summer. Two osprey platforms have been added to the refuge in hopes to lure in nesting birds. State species of special concern that utilize the refuge are the black-crowned night-heron (*Nycticorax nycticorax*) and northern harrier (*Circus cyaneus*). The black-crowned night-heron nested (52 nests reported) at the site prior to 1996 but are now considered transient. Northern harrier is observed less frequently at the site since grassland buffer habitat has disappeared due to habitat successional changes and development. The green-winged teal (*Anas crecca*) and marsh wren

(*Cistothorus palustris*) are State rare that nest at the refuge. The pied-billed grebe (*Podilymbus podiceps*), American coot (*Fulica americana*), Wilson's snipe (*Gallinago delicata*), Swainson's thrush (*Catharus ustulatus*), prothonotary warbler (*Protonotaria citrea*) and summer tanager (*Piranga rubra*) are other State candidate-rare species that have been observed at the refuge as well (Cohen and Johnson 2004).

Mammals

John Heinz NWR is one of 44 Important Mammal Areas designated by the Pennsylvania Wildlife Federation. The designation was awarded noting the refuge as supporting northern river otter use on occasion and being the last potential location for the marsh rice rat (*Oryzomys palustris*) in the State.

While no formal inventories have been conducted to date, numerous mammals are known to inhabit the refuge. Two nonnative species present include the Norway rat (*Rattus norvegicus*) and house mouse (*Mus musculus*). The gray squirrel (*Sciurus carolinensis*) is a common species found throughout upland habitats of the refuge, where it plays an important role in seed dispersal. Other common open space species supported by the refuge include the northern short-tailed shrew (*Blarina brevicauda*); the meadow vole (*Microtus pennsylvanicus*), white-footed mouse (*Peromyscus leucopus*) and several other rodent species, as well as raccoons (*Procyon lotor*), mink (*Mustela vison*), skunks (*Mephitis mephitis*), opossums (*Didelphis virginiana*), eastern cottontail rabbit (*Sylvilagus floridanus*) (PNHP 2008). Woodchuck (*Marmota monax*) and red fox (*Vulpes vulpes*) have been observed damaging the impoundment levee system as they attempt to burrow dens into dikes (Stolz, personal communication 2008). Feral domestic house cats pose a serious invasive mammalian predatory threat to all small native wildlife (birds, mammals, reptiles and amphibians) and need to be removed from the refuge when found.

Muskrat (*Ondatra zibethica*), long-tailed weasel (*Mustela frenata*), and least shrew (*Cryptotis parva*) are fairly common. Recent records also indicate beaver (*Castor canadensis*) and river otter (*Lontra canadensis*) occur occasionally on the refuge. It is also likely that the refuge sees occasional use by coyotes, which have been documented on adjacent property at Philadelphia International Airport (Stolz, personal communication 2008). Bats are frequently observed on the refuge during warmer seasons and a formal species diversity and population survey would provide valuable information with recent declines of these important creatures due to white nose syndrome and habitat disturbances.

White-tailed deer (*Odocoileus virginianus*) are another mammal species supported by the refuge. Refuge staff has conducted on-the-ground deer population surveys for several years. These surveys have been conducted by counting deer driven systematically from various portions of the refuge. Although this method does have potential for error, such as omitting or double counting individuals (McCullough 2001), the results of these surveys consistently record population numbers in the range of 200 to 240 deer per square mile. Given that the refuge currently covers approximately 1,000 acres (about 1.5 square miles) of marsh and upland ecosystems, the refuge's current density ranges between 133 to 160 deer per square mile. Density levels at which a deer population is considered "ecologically sustainable" varies depending on the habitat involved and the variables studied. A separate deer and songbird population relationship study in northwestern Pennsylvania concluded that the threshold level for negative effects on songbird richness was between 20 and 38 deer per square mile (deCalesta 1994). Additional research has shown a population density not exceeding 20 deer per square mile is optimal for forest regeneration (Rooney 2001). The Service and the USDA Division of Wildlife Services have drafted a deer management plan. Once finalized, this plan will provide detailed guidance on management of the resident deer population based on observable impacts to (and recovery of) the refuge's habitats, not on a particular density target (D'Angelo personal communication 2009).

Reptiles and Amphibians

While no formal inventories have been conducted, there are eight turtle, three snake, and eight frog and toad species known to inhabit the refuge. Common frog and toad species such as bull frog (*Rana catesbeiana*), green frog (*Rana clamitans melanota*), wood frog (*Rana sylvatica*), pickerel frog (*Rana palustris*), spring peeper (*Pseudacris crucifer*), American toad (*Bufo americanus*), and Fowler's toad (*Bufo woodhousei fowleri*) have all been heard calling during their respective breeding seasons. The State-endangered species, southern leopard frog (*Rana sphenoccephala* or *Rana utricularia*), is known to inhabit and breed at the refuge in shallow open water and isolated vernal pools.

The northern water snake (*Nerodia sipedon sipedon*), eastern garter snake (*Thamnophis sirtalis sirtalis*), and northern brown snake (*Storeria dekayi dekayi*) are all found at the refuge. These common species are generally associated with forested habitats and nearby open water.

Numerous turtles are known to use the open water habitats of the impoundment, freshwater tidal marsh, and Darby Creek. Species common to these habitats at the refuge include common musk turtle (*Sternotherus odoratus*), eastern box turtle (*Terrapene c. carolina*), painted turtle (*Chrysemys picta x marginata*), common map turtle (*Graptemys geographica*), eastern spiny softshell turtle (*Apalone spinifera*) and the nonnative, invasive red-eared slider (*Trachemys scripta elegans*) (USFWS 2009b). The refuge also supports several rare species of turtle such as the northern diamond-backed terrapin (*Malaclemys terrapin*) and a significant population of the State-threatened eastern redbelly turtle (*Pseudemys rubriventris*). The refuge also contains habitat for the recently-documented eastern mud turtle (*Kinosternon subrubrum*) (PFBC 2012), previously thought to be extirpated from Pennsylvania. These rare species are more commonly associated with the freshwater tidal marsh and open waters of Darby Creek. However, some of these have been known to move to and from the 145-acre impoundment as well.

Historically, the refuge and surrounding lands supported additional species of reptiles. The wood turtle (*Clemmys insculpta*) has been identified on lands adjacent to the refuge (Sunoco tank farms). Although considered extirpated in Pennsylvania, a gravid female eastern mud turtle was documented in nearby, from a road kill, in Bucks County in 2008. State surveys for the species were then conducted by East Stroudsburg State University including the refuge and two small populations of eastern mud turtles were found in nearby Bucks County with continued hopes that they may still or in the future be rediscovered on the refuge (Stolz, personal communication 2010).

A number of other reptile and amphibian species native to southeast Pennsylvania could potentially be discovered on the refuge where suitable habitat occurs within their native ranges. Such species include black rat snake, black racer, eastern ribbon snake, eastern milk snake, five-lined skink, eastern fence swift, gray tree frog, eastern chorus frog, red-backed salamander, long-tailed salamander, dusky salamander, red salamander, and spotted salamander. Numerous nocturnal anuran vocalization surveys have been conducted as well as turtle mark-recapture studies with Drexel University and University of Philadelphia. At this time, a herpetological survey that includes terrestrial habitat and breeding areas to establish baseline data is necessary for long-term management of the refuge's reptile and amphibian fauna. Dr. Jim Spotila of Drexel University has indicated turtle nest predation on the refuge may be as high as 98 percent (most likely from raccoon, red fox, skunk and opossum) (Stolz personal communication 2009).

Fish

The refuge provides important aquatic habitat as well as terrestrial habitat. Freshwater tidal marshes, like Tinicum Marsh, are used by many aquatic species for spawning, year-round food and shelter, and as a nursery and rearing habitat (Mitch and Gosselink 1993). Freshwater tidal marshes are also a mixing zone for various groups of fish typically associated with certain habitats. Freshwater species, such as sunfish (*Lepomis spp.*) and catfish (*Ictalurus spp.*), estuarine species including killifishes (*Fundulus diaphanus*) and mummichogs (*Fundulus heteroclitus*), anadromous species including gizzard shad (*Dorosoma cepedianum*) and herrings (*Alosa spp.*), and the catadromous American eel (*Anguilla rostrata*) can all be found within Tinicum Marsh. A list of fish species observed on the refuge and in adjacent similar marsh areas around the Philadelphia International Airport can be found in table 3.6 (Herpetological Associates 2001; NOAA 2000; Sweka and Mohler 2010; Stolz personal communication 2011).

Darby Creek and the open water areas of the freshwater tidal marsh may also provide suitable habitat for the Federal and State-endangered shortnose sturgeon (*Acipenser brevirostrum*) and Atlantic sturgeon (*Acipenser oxyrinchus*) (PNHP 2008; PGC and PFBC 2008). While this species has not been confirmed within the refuge itself, it is known to occur in the nearby Delaware River, thus making protection of suitable habitat within the refuge a priority.

In June 2011, refuge staff confirmed the first record of a bowfin (*Amia calva*), a Pennsylvania candidate rare species, within the refuge boundaries. The individual fish was caught during a refuge interpretive fishing event and released back into waters located on the refuge. Another sighting of this species also occurred adjacent to the refuge in 2010 near the Ridley Park Marina along Darby Creek (Stolz personal communication 2011). In 2012, a nonnative, invasive northern snakehead was captured by an angler on the refuge. While the refuge had received reports of snakeheads in the past, this was the first confirmed capture. Of even greater concern was the angler's account of behavior that indicated there could be additional adults and potential spawning behavior.

Invertebrates

While few invertebrate inventories have been conducted to date within the refuge or along Darby Creek, recent findings along the nearby Delaware River indicate that invertebrate conservation may be an added focus along Darby Creek. A series of mussel beds was identified in the stretch of river connected to the confluence with Darby Creek. Seven mussel species were identified within the Delaware River, including two species which were thought to be extinct in Pennsylvania and New Jersey: the alewife floater (*Anodonta imbecilis*), and the tidewater mucket (*Leptodea ochracea*). Other species included one species considered critically imperiled, the pond mussel (*Ligumia nasuta*), three species considered vulnerable: the creeper (*Strophitus undulatus*), yellow lampmussel (*Lampsilis cariosa*), and the eastern floater (*Pyganodon cataracta*) and one common species: the eastern elliptio (*Elliptio complana*).

Benthic macroinvertebrate sampling has been conducted upstream of the refuge in conjunction with water quality monitoring and characterization. No species of conservation concern were identified in those surveys. It is possible that crayfish species of conservation interest occur on the refuge including *Cambarus diogenes* and *C. acuminatus* (PFBC 2012). Nonnative crayfish species may also occur on the refuge.

To our knowledge, no terrestrial invertebrate inventories have been conducted on the refuge to date.

Table C.2. Fish Species and Utilization of Lower Darby Creek and Freshwater Tidal Marsh Habitats (Herpetological Associates 2001; NOAA 2000; Sweka and Mohler 2010)

Species		Habitat Use			
Scientific Name	Common Name	Spawning Area	Nursery Grounds	Shelter	Adult Forage
Freshwater Species					
<i>Ameiurus catus</i>	White catfish	~	~	~	~
<i>Ameiurus nebulosus</i>	Brown bullhead	~	~	~	~
<i>Catostomus commersoni</i>	White sucker	~	~		~
<i>Channa argus</i>	Northern snakehead	?	?	?	-
<i>Cyprinus carpio</i>	Common carp	~	~		~
<i>Etheostoma olmstedii</i>	Tessellated darter	~	~	~	~
<i>Gambusia holbrooki</i>	Eastern mosquitofish	~	~	~	~
<i>Hybognathus regius</i>	Eastern silvery minnow	~	~	~	~
<i>Ictalurus punctatus</i>	Channel catfish	~	~	~	~
<i>Lepomis cyanellus</i>	Green sunfish	~	~		~
<i>Lepomis gibbosus</i>	Pumpkinseed	~	~		~
<i>Lepomis macrochirus</i>	Bluegill	~	~		~
<i>Micropterus salmoides</i>	Largemouth bass	~	~		~
<i>Notemigonus crysoleucas</i>	Golden shiner	~	~	~	~

Species		Habitat Use			
Scientific Name	Common Name	Spawning Area	Nursery Grounds	Shelter	Adult Forage
<u>Freshwater Species (cont)</u>					
<i>Notropis hudsonius</i>	Spottail shiner	~	~	~	~
<i>Perca flavescens</i>	Yellow perch	~	~		~
<i>Pimephales notatus</i>	Bluntnose minnow	~	~		~
<i>Poxomis nigromaculatus</i>	Black crappie	~	~		~
<i>Umbra pygmaea</i>	Eastern mudminnow	~	~	~	~
<u>Estuarine-Marine Species</u>					
<i>Brevoortia tyrannus</i>	Atlantic menhaden				~
<i>Fundulus diaphanus</i>	Banded killifish	~	~	~	~
<i>Fundulus heteroclitus</i>	Mummichog	~	~	~	~
<i>Leiostomus xanthurus</i>	Spot	~	~		~
<i>Menedia beryllina</i>	Inland silversides	~	~	~	~
<i>Micropogonias undulatus</i>	Atlantic croaker	~	~		
<i>Trinectes maculatus</i>	Hogchoker		~	~	~
<u>Anadromous Species</u>					
<i>Alosa aestivalis</i>	Blueback herring	~	~	~	
<i>Alosa mediocris</i>	Hickory shad	~	~	~	
<i>Alosa pseudoherangus</i>	Alewife	~	~	~	
<i>Dorosoma cepedianum</i>	Gizzard shad	~	~		~
<i>Morone saxatilis</i>	Striped bass		~		~
<i>Morone americana</i>	White perch	~	~		~
<i>Mugil cephalus</i>	Striped mullet		~		
<u>Catadromous Species</u>					
<i>Anguilla rostrata</i>	American eel		~	~	~

Nonnative, Invasive Plants

Federal management of nonnative, invasive plant species is guided by the planning efforts outlined in Executive Order 13112 signed into law on February 3, 1999. The Executive Order requires that a Council of Departments dealing with invasive species be created and develop a National Invasive Species Management Plan every 2 years. The first such plan was released in January 2001, providing the basis for Federal management of invasive species. The Executive Order defines an invasive species as a species that is a) nonnative to the ecosystem under consideration and b) whose introduction causes (or is likely to cause) economic or environmental harm to human health.

The planning and inventory work completed as part of the Restoration Management Plan for the Lower Darby Creek in 2005 identified invasive plant species as one of the top impacts to refuge plant communities and a management priority for the coming years. The inventory identified nonnative invasive species present throughout John Heinz NWR and ranked their management priority based on (a) the extent to which the species is established on the refuge, (b) the potential ecological impact of the species on refuge plant communities, and (c) the degree of management difficulty involved in controlling the species. The results of this inventory and prioritization are included in table C.3 (Salas et al. 2006). Management prescriptions for identified invasive species are included in appendix B.

Recent Research and Monitoring Projects

Impoundment Management Study

From 2005 to 2007, John Heinz NWR participated in the Service's Region 3 and Region 5 Impoundment Management Study. The goal of this study was to determine the effects of timed water level management related to use by waterfowl, shorebirds, and wading birds. This study found that waterfowl were observed throughout the year, while shorebirds and waders were observed primarily between April and October. Shorebird frequencies peaked around the spring and fall migration periods, and wader frequencies peaked in mid-summer. Shorebird species composition was dominated by peeps (semipalmated sandpiper, unidentified peep, least sandpiper) in both the spring (approximately 80 percent of all shorebirds observed) and fall (approximately 90 percent). Waterfowl species most abundant during the spring migration period were ducks. Four species (northern shoveler, green-winged teal, mallard, northern pintail) accounted for less than 70 percent of the waterfowl during that period. Species composition was similar during the fall, with mallards and gadwall accounting for 47 percent of the waterfowl seen. Canada geese became the second-most abundant species during this same period. Great egrets and great blue herons dominated the waders observed during the breeding season (Green et al. 2008).

White-tailed Deer Research and Management Plan

In 2008, the Service contracted with the USDA, APHIS-WS to assist in studying the impacts of the deer population on plant communities within the refuge. Based on their analysis, they reported that the white-tailed deer population at John Heinz NWR was believed to surpass the carrying capacity of available habitat, causing severe ecological damage that negatively affected all other native species of plants and animals.

Table C.3. Invasive Species Identified at John Heinz NWR and Their Associated Management Ranking.

Species	Ranking	Impact	Extent	Management Difficulty	Control Priority and Focus
Japanese knotweed	1	●	○	●	High Prevent New Introductions and Eradicate Localized Occurrences
<i>Polygonum cuspidatum</i>					
Porcelainberry	2	○	○	○	
<i>Ampelopsis brevipedunculata</i>					
Multiflora rose	3	○	○	○	
<i>Rosa multiflora</i>					
Reed canarygrass	4	○	○	○	
<i>Phalaris arundinacea</i>					
European privet	5	○	○	○	
<i>Ligustrum arvense</i>					
Common Reed	6	●	○	●	
<i>Phragmites australis</i>					
Purple Loosestrife	7	●	○	●	
<i>Lythrum salicaria</i>					

Species	Ranking	Impact	Extent	Management Difficulty	Control Priority and Focus
Mile-a-minute weed	8	●	○	○	Medium Eradicate Localized Occurrences and Reduce Size of Existing Populations
<i>Polygonum perfoliatum</i>					
Japanese honeysuckle	9	●	○	●	
<i>Lonicera japonica</i>					
Norway maple	10	○	○	●	
<i>Acer platanoides</i>					
Oriental bittersweet	11	○	○	○	
<i>Celastrus orbiculatus</i>					
Tree-of-heaven	12	○	○	○	
<i>Ailanthus altissima</i>					
Japanese hops	13	○	○	○	
<i>Humulus japonica</i>					
Bush honeysuckle	14	○	○	○	Low Focus Primarily on Areas of Conservation Significance
<i>Lonicera maackii</i>					
Japanese stiltgrass	15	●	●	○	
<i>Microstegium vimineum</i>					
Garlic mustard	16	●	●	●	
<i>Alliaria petiolata</i>					

● = High

○ = Medium

○ = Low

Chapter 3. Resources of Concern

- 3.1 Introduction**
- 3.2 Potential Resources of Concern**
- 3.3 Biological Integrity, Diversity, and Environmental Health**
- 3.4 Priority Resources of Concern**
- 3.5 Priority Habitat Types and Associated Focal Species**
- 3.6 Conflicting Habitat Needs**
- 3.7 Adaptive Management**

3.1 Introduction

Resources of concern are the focal point of the HMP. The HMP policy (620 FW 1) defines “resources of concern” as “All plant and/or animal species, species groups, or communities specifically identified in refuge purpose(s), [Refuge] System mission, or international, national, regional, state, or ecosystem conservation plans or acts. For example, waterfowl and shorebirds are a resource of concern on a refuge whose purpose is to protect “migrating waterfowl and shorebirds.” Federal or state threatened and endangered species on that same refuge are also a resource of concern under terms of the respective endangered species acts.”

The Service is entrusted by Congress to conserve and protect migratory birds, federally listed threatened and endangered species, interjurisdictional fish, and certain marine mammals (trust species). Each refuge also has its own specified purpose(s) for which it was created, which guide its management goals and objectives. Within these purposes, refuges support other elements of biological diversity such as locally rare plants, invertebrate and vertebrate species, natural communities, and the ecological processes that contribute to the biological integrity and environmental health at the refuge, ecosystem, and broader scales (USFWS 1999, 2003).

The first step in developing a habitat management strategy is to define a refuge’s resources of concern in light of the multiple mandates, policies, purposes, and regional and national plans applicable to the particular refuge. The resources of concern need to be identified and prioritized in order to best focus the management objectives of the refuge. The following details the resources considered in development of John Heinz NWR resources of concern.

3.2 Potential Resources of Concern

There are many national, regional, State, and local plans and reports that have identified conservation concerns for areas in and around John Heinz NWR. The myriad of species and management recommendations provided in each plan was compiled into a list of potential resources of concern that cross referenced each plan and priority focus with a particular species noted of conservation significance. The final resources of concern were developed based on the priority species of greatest significance that were most likely to be impacted by management, and existing and future habitat at the refuge.

Refuge Purpose

John Heinz NWR was created in 1972 for three primary purposes:

1. “Preserving, restoring, and developing the natural area known as Tinicum Marsh....a wildlife interpretative center for the purpose of promoting environmental education, and to afford visitors an opportunity for the study of wildlife in its natural habitat.” (86 Stat. 891, dated June 30, 1972).
2. To be of “particular value in carrying out the national migratory bird management program.” 16 U.S.C. § 667b (An Act Authorizing the Transfer of Certain Real Property for Wildlife).
3. “Development, advancement, management, conservation, and protection of fish and wildlife resources... (16 U.S.C. § 742f(a)(4))...for the benefit of the U.S. Fish and Wildlife Service, in performing its activities and services...(16 U.S.C. § 742f(b)(1)) (Fish and Wildlife Act of 1956).

The Service is mandated to manage John Heinz NWR to fulfill the purpose for which it was created. Thus, the resources of concern identified for the refuge must protect Tinicum Marsh, support the migratory bird management program, or protect fish and wildlife resources.

Service Trust Resources

While the refuge purpose is the foremost determinant of a particular refuge's management, managing trust resources is also a priority of refuges. Trust resources include:

Migratory Birds

A list of all species of migratory birds protected by the Migratory Bird Treaty Act (16 U.S.C. 703–711) and subject to the regulations on migratory birds are contained in subchapter B of title 50 CFR §10.13. The Service's Migratory Bird Program also maintains subsets of that list that provide priorities at the national, regional, and ecoregional (bird conservation region) scales. The primary sources of information that the refuge used to identify potential migratory birds species of concern included the following:

- BCR 30, PIF Physiographic Area 44
- Continental and regional plans for landbirds, waterfowl, shorebirds, and marshbirds
- Rocky Mountain Bird Observatory Species Assessment Database
- Service Birds of Conservation Concern (USFWS 2008b)
- Status and trend information for refuge bird surveys and regional assessments

Interjurisdictional Fish

Interjurisdictional fish include "populations that two or more states, nations, or Native American Tribal governments manage because of their geographic distribution or migratory patterns (710 FW 1.5H)." Examples include anadromous species of salmon and free-roaming species endemic to large river systems, such as paddlefish and sturgeon (Director's Order No. 132, 6[c]). The primary sources of information that the refuge used to identify potential aquatic habitats and fish species of concern included the following:

- Service Regional Fisheries Office List of Priority Fisheries
- National Fish Habitat Action Plan (Sportfishing and Boating Partnership Council 2006)

Wetlands

Wetlands provide habitat for approximately one-third of federally listed species and for migratory waterfowl. The Emergency Wetlands Resources Act of 1986 (Pub. L. 99–645 (100 Stat. 3582), approved November 10, 1986, authorizes the purchase of wetlands from Land and Water Conservation Fund. It requires the Secretary to establish a National Wetlands Priority Conservation Plan, which requires the states to include wetlands in their Comprehensive Outdoor Recreation Plans.

The refuge's wetlands are unique to Pennsylvania as they protect the last one-third square mile of freshwater tidal marsh remaining in the State (PNHP 2008).

Threatened and Endangered Species

The Endangered Species Act (16 U.S.C. 1531–1544, December 28, 1973, as amended 1976 to 1982, 1984 and 1988) states in Sec. 8A.(a) that, "*The Secretary of the Interior (hereinafter in this section referred to as the "Secretary") is designated as the Management Authority and the Scientific Authority for purposes of the Convention and the respective functions of each such Authority shall be carried out through the U.S. Fish and Wildlife Service.*"

The act also requires all Federal departments and agencies to conserve endangered species and threatened species and that they shall utilize their authorities in furtherance of the purposes of this act.

To identify federally listed, threatened or endangered species of relevance to John Heinz NWR, we reviewed the following:

- The Federal List of Threatened and Endangered Species
- Recovery Plans for federally listed species in our region

3.3 Biological Integrity, Diversity, and Environmental Health

The Refuge Improvement Act states that, in administering the Refuge System, the Service shall “ensure that the biological integrity, diversity, and environmental health of the System are maintained...” (601 FW 3; also known as the “Integrity Policy”). The Service (2003) defines these terms as follows:

<i>Biological Diversity</i>	The variety of life and its processes, including the variety of living organisms, the genetic differences between them, and the communities and ecosystems in which they occur.
<i>Biological Integrity</i>	Biotic composition, structure, and functioning at genetic, organism, and community levels comparable with historic conditions, including the natural biological processes that shape genomes, organisms, and communities.
<i>Environmental Health</i>	Composition, structure, and functioning of soil, water, air, and other abiotic features comparable with historic conditions, including the natural abiotic processes that shape the environment.

Where possible, refuge management restores or mimics natural ecosystem processes or functions that support fish and wildlife and thereby maintain biological diversity, integrity, and environmental health (BIDEH). Given the continually changing environmental conditions and landscape patterns of the past and present (e.g., rapid development, climate change, sea level rise), relying on natural processes is not always feasible, nor always the best management strategy, for conserving wildlife resources. Uncertainty about the future requires that the refuge manage within a natural range of variability rather than emulating an arbitrary point in time. Rather than trying to maintain stability, we will maintain mechanisms that allow species, their genetic strains, and the natural communities they rely upon to evolve with changing conditions.

Meretsky et al. (2006) stated that the Integrity Policy directs refuges to assess their importance across landscape scales and “forge solutions to problems arising outside refuge boundaries.” Regional land use problems include habitat fragmentation and lack of connectivity, high levels of contaminants, and incompatible development or recreational activities.

To manage the natural communities and the habitats they support within the natural range of variability, a review of maps, reports, and other resources was completed to assess historic, current, and future potential for the refuge. To assess the historical condition, site capability, current regional landscape conditions, biological diversity, and environmental health data pertinent to the refuge, the following resources were used:

- Maps and associated data on site history and capabilities:
 - ◆ Kuchler’s (1964) potential natural vegetation
 - ◆ 1757 Map of Philadelphia and Parts Adjacent
 - ◆ 1850 Map of Philadelphia and Baltimore Railroad routes adjacent to current refuge lands
 - ◆ 1898 Topographic Map of Philadelphia and Delaware Counties
 - ◆ 1968 Vegetation Survey Map from *Two Studies of Tinicum Marsh* (McCormick et al. 1970)
- Maps of existing landscape conditions displaying watershed boundaries, habitat connectivity, as well as land use conditions and trends surrounding the refuge
- Maps of existing natural communities and invasive species distributions within the refuge
- Soil Survey of Philadelphia and Delaware Counties
- Global and regional trends in climate change and water quality
- Pennsylvania’s Natural Heritage Program information on rare, declining, threatened, or endangered species, as well as unique natural communities
- Pennsylvania’s Wildlife Action Plan (PGC and PFBC 2005)
- Status and trend information for potential species of concern as documented in regional and State assessments and reports.

Based on a review of the existing and historical data listed above, a list of habitats that contain naturally occurring elements of BIDEH was developed in order to determine those habitats that contain the most ecological and biological integrity (see table C.4).

Table C.4. Summary of Habitats that Represent Existing BIDEH for John Heinz NWR.

Habitat Type	Populations and Habitat Attributes	Natural Processes Responsible for These Conditions	Limiting Factors and Threats
(Plant communities that represent existing BIDEH)			
Freshwater Tidal Marsh	<p>Mix of several native herbaceous species dominated plant communities: <i>Atlantic Coast Wild Rice Tidal Marsh</i>; <i>Mixed Forbs High Marsh</i>; <i>Nuphar lutea Tidal Marsh</i>; <i>Peltandra virginica</i> - <i>Pontederia cordata Tidal Marsh</i>; <i>Typha (angustifolia, latifolia)</i> - (<i>Schoenoplectus spp.</i>) <i>Marsh</i></p> <p><i>Potential Conservation Species: supports a variety of fish, landbirds, waterbirds, waterfowl, and shorebirds.</i></p>	<p>Tidal hydrology in combination with marsh surface elevation. Natural accretion of alluvial sediments across marsh surface. Development of natural channel morphology within marsh plain.</p>	<p>Altered hydrology; water quality degradation and contamination; invasive species; sea level rise.</p>
Coastal Plain Forest	<p>Pin oak (<i>Quercus palustris</i>) - Swamp white oak (<i>Quercus bicolor</i>) - sweetgum (<i>Liquidambar styraciflua</i>) Mixed Hardwood Forest. General characteristics include: Oaks occupy at least 25 percent of canopy. Shrub and vine species are variable and may include dogwoods (<i>Cornus spp.</i>), spicebush (<i>Lindera benzoin</i>), virginia creeper (<i>Parthenocissus quinquefolia</i>), and elderberry (<i>Sambucus canadensis</i>). Herbaceous species vary but generally include a mix of sedges (<i>Carex spp.</i>), wild rye (<i>Elymus spp.</i>), bittercress (<i>Cardamine spp.</i>), mayapple (<i>Podophyllum sp.</i>), and other species.</p> <p><i>Potential Conservation Species: American woodcock, northern oriole, wood thrush, southern leopard frog.</i></p>	<p>Seasonally wet or saturated silt and clay soils; regeneration of dominant canopy species through a combination of period fire of canopy openings.</p>	<p>Excessive deer browse prevent forest regeneration, reducing species diversity, and loss of native shrub layer; Invasive species outcompete remaining native species.</p>

Habitat Type	Populations and Habitat Attributes	Natural Processes Responsible for These Conditions	Limiting Factors and Threats
(Plant communities that represent existing BIDEH)			
Floodplain Forest	Mix of multiple hardwood forest plant communities. General characteristics include: red and silver maple, and boxelder (<i>Acer rubrum</i> , <i>saccharinum</i> and <i>negundo</i>), green ash (<i>Fraxinus pensylvanica</i>), and willow (<i>Salix nigra</i>) canopy. Shrub species may include spicebush (<i>Lindera benzoin</i>), winterberry (<i>Ilex verticillata</i>), and elderberry (<i>Sambucus canadensis</i>). Herbaceous species vary but generally include a mix of sedges (<i>Carex</i> spp.), wild rye (<i>Elymus</i> spp.), touch-me-not (<i>Impatiens</i> spp.), manna-grass (<i>Glyceria</i> sp.), and other species.	Seasonally flooded or saturated silt and clay soils; Regeneration of dominant canopy species through flood-induced canopy openings.	Excessive deer browse prevent forest regeneration, reducing species diversity, and loss of native shrub layer; Invasive species outcompete remaining native species.
	<i>Potential Conservation Species: American woodcock, northern oriole, wood thrush, southern leopard frog.</i>		
Darby Creek	Open, tidal-influenced, flowing water; spawning habitat for estuarine and anadromous; provides fish passage to spawning areas in upper reaches of nontidal reaches of Darby Creek; provides forage for a variety of mammals, reptiles, amphibians, and birds.	Perennial tidal flows and periodic flooding. Open water with periodic mudflats.	Environmental contaminants; Degraded water quality; upstream migration barriers; sea level rise
	<i>Potential Conservation Species: alewife, blueback herring, American eel</i>		

Habitat Type	Populations and Habitat Attributes	Natural Processes Responsible for These Conditions	Limiting Factors and Threats
(Plant communities that represent existing BIDEH)			
Wet Meadows and Grasslands	Mix of native warm and cool season grasses and forbs including little bluestem (<i>Schizachyrium scoparium</i>), indiagrass (<i>Sorghastrum nutans</i>), switchgrass (<i>Panicum virgatum</i>), wild rye (<i>Elymus</i> spp.), asters (<i>Symphyotrichum</i> spp.), goldenrods (<i>Soldago</i> spp.), bergamot (<i>Monarda fistulosum</i>), and other species.	Naturally maintained by periodic fire; contain seasonal saturation or flooding.	Loss of species and structure due to natural succession; invasive species outcompete native grass and forb species; patch size typically too small to provide nesting opportunities for grassland birds; requires intensive and regular maintenance
	<i>Potential Conservation Species: American woodcock, sedge wren, short-eared owl</i>		

3.4 Priority Resources of Concern

The potential resources of concern table (appendix C) contain a large number of species with a broad array of habitat needs. Prioritizing those species and their habitats is necessary in order to determine where to focus refuge management strategies. This process must consider to which species and habitats the refuge can make the greatest contribution in the context of the Refuge System, its surrounding landscape, and state, regional, and national priorities. To guide this process, the following concepts were considered:

- Achieving refuge purposes and managing for trust resources as well as biological diversity, integrity, and environmental health can be addressed through the habitat requirements of “focal species” or species that may represent guilds that are highly associated with important attributes or conditions within habitat types. The use of focal species is particularly valuable in addressing Service trust resources such as migratory birds.
- Indicator species can be used as a representative of BIDEH. Indicator species presence, absence, abundance, or relative well-being in a given habitat niche serves as a marker of overall health of its required habitat type. For example, where the Delmarva fox squirrel served as an umbrella species for mixed hardwood forest habitats at Prime Hook NWR, the long-horned beetle (*Prionus laticollis*) can serve as an excellent indicator species of oak-dominated hardwood habitats as it is only found in healthy, mature oak stands with diverse mixed hardwood associates.
- Reference habitats and ecological communities can provide comparison data for habitat management where BIDEH parameters of refuge habitats have been degraded or severely impacted. Reference areas of freshwater tidal marsh (both on and off refuge) that contain intact BIDEH parameters can be utilized to compare both the degree of impacts to degraded marsh areas, as well as provide a measure of management success.
- BCR plans are increasing their effectiveness at ranking and prioritizing those migratory birds most in need of management of conservation focus. Although all species that make it to a ranked BCR priority list are in need of conservation attention, we selected focal species that ranked as High or Moderate in Continental Concern with a High to Moderate BCR Responsibility. See www.abcbirds.org/nabci.com for BCR rules used to rank birds.
- Focal species selected that were not birds (e.g., red-bellied turtle, American eel, southern leopard frog) were identified as resources of concern due to concern over their population status range wide, because they are under review for inclusion on the Federal List of Endangered and Threatened Species, or because the Pennsylvania Wildlife Action Plan or Natural Heritage Program identified them as conservation priorities. Fish species were reviewed using regional and State conservation priorities and Federal trust species and trends.
- Habitat conditions on or around the refuge may limit its capability to support or manage for a potential species of concern. We evaluated the following site-specific factors:
 - ◆ Patch size requirements
 - ◆ Habitat connectivity
 - ◆ Incompatibility of surrounding land uses
 - ◆ Environmental conditions: soils, hydrology, disturbance patterns, contaminants, predation, invasive species
 - ◆ Specific life history needs
- The likelihood that a potential species of concern would have a positive reaction to management strategies.
- The ability to rely on natural processes to maintain habitat conditions within a natural range of variability suitable to the focal species.

- The ability to use adaptive management (flexibility and responsiveness of the refuge and the habitats) in the face of changing environmental conditions (e.g., climate change).

Table C.5 lists the priority resources of concern (and their primary focal species) for the refuge based on the information compiled and analyzed for this plan. Priority resources of concern are similar to “conservation targets” and the terms can be used interchangeably.

Table C.5. Priority Resources of Concern and Associated Focal Species for John Heinz NWR.

Habitat	Species		Utilization By Species
Freshwater Tidal Marsh	Birds	American Bittern	B,M
		American Black Duck	B,M
		Black-bellied Plover	M
		Greater Yellowlegs	M
		King Rail	B,M
		Least Bittern	B,M
		Marsh Wren	B,M
		Sedge Wren	B,M
		Short-eared Owl	B,M
	Reptiles	Red-bellied Turtle	B,Y
Impoundment and Open Water	Birds	Black-crowned Night Heron	B,M
		Great Egret	B,M
		Least Tern	M
		Bald Eagle	M,W
	Reptiles	Red-bellied Turtle	B,Y
Coastal Plain and Floodplain Forests	Birds	American Woodcock	B,M
		Northern Oriole	B,M
		Prothonotary Warbler	M
		Wood Thrush	B,M
		Worm-eating Warbler	M
	Amphibian	Southern leopard frog	B,Y
Darby Creek	Birds	Bald Eagle	M,W
	Fish	Alewife	B, J
		Blueback Herring	B, J
		Striped Bass	B, J, Y
		American Eel	B, J

Utilization Codes:

B - Breeding

M - Migratory

W - Wintering

Y – Year-round

J - Juvenile or nursery habitat

3.5 Priority Habitat Types and Associated Focal Species

Refuge management most often focuses on restoring, managing, or maintaining habitats or certain habitat conditions to benefit a suite of focal species or a suite of plants and animals associated with a particular habitat. The priority habitats of John Heinz NWR were identified (table C.6) based on information compiled (e.g., site capability, historic condition, current vegetation, conservation needs of wildlife associates). As part of that process, we identified any limiting factors that affect the refuge’s ability to maintain those habitats. Since all management activities cannot feasibly be undertaken at the same time, we have prioritized habitats (table C.7) based on the following ranking factors:

- Where management actions would provide the greatest conservation benefit to identified priority species
- Current habitat conditions and the urgency of needs for active management
- Landscape-level rankings for particular habitats

Although a habitat may be ranked as “moderate” priority, this should not be interpreted as meaning that the habitat type does not provide valuable habitat to a variety of species or contribute to the overall diversity, integrity, and health of the refuge. In some cases, habitats may not require active management by the refuge, or may represent an area where there is little management capability.

Table C.6. Focal Species, Associated Habitat Requirements, and Other Species Benefitting from Habitat Management at John Heinz NWR.

Focal Species	Habitat Type	Habitat - Vegetation Structure
American Bittern	Freshwater Tidal Marsh	Platform nests constructed of reeds and grasses near the water. Found in marshes and wetland borders along lakes, ponds, rivers, and streams (Stewart and Robbins 1958, Swift 1987).
Black-bellied Plover		Breeding in northern tundra. Nonbreeding habitat includes mudflats, beaches, wet savanna, shores of ponds and lakes, wet meadows, flooded fields (Stiles and Skutch 1989). Feeds on insects and crustaceans (Terres 1980).
Greater Yellowlegs		Nonbreeding habitat includes marshes, ponds, lakes, stream margins and sand and gravel bars, lagoons, and coastal mudflats (AOU 1983, Stiles and Skutch 1989). Nests in muskeg country or at other wetlands near water.
King Rail		Nest is an elevated platform, often with a canopy and ramp, attached to plants in shallow water or waterside vegetation. Freshwater marshes, upland-wetland marsh edges (Harrison 1978, Meanley 1969).
Least Bittern		Nest is placed near open water in dense vegetation. Freshwater marshes with dense, grass-like vegetation (Palmer 1962, Kushlan 1973, Aniskowicz 1981, Weller 1961).
Marsh Wren		Nests in marsh vegetation. Found in freshwater marshes in cattails, bulrush, and reeds (AOU 1983).
Short-eared Owl		Nests on ground, generally in slight depression, often beside or beneath a bush or clump of grass. Many nests are near water but generally are on dry sites. Hunts in meadows, marshes and open lands (Bent 1938, Clark 1975, Terres 1980).
Sedge Wren		Nesting takes place among dense, tall growths of sedges and grasses in wet meadows/marshes. Breeding habitat includes marshes; moist meadows with scattered low bushes; upland margins of ponds and marshes (AOU 1983, Harrison 1978).
Eastern Redbelly Turtle		Nests dug in soft soil in open areas near water, often in disturbed sites. Resides in relatively large deep bodies of water: creeks, rivers, marshes, ponds (USFWS 1981, DeGraaf and Rudis 1983, Ernst and Barbour 1972).

Focal Species	Habitat Type	Habitat - Vegetation Structure
American Black Duck	Impoundment and Open Water	Nest sites are very diverse; favors wooded swamps and marshes, shallow margins of lakes, streams, bays, mud flats, and open waters (Frazer et al. 1990a and 1990b, Merendino and Ankney 1994).
Bald Eagle		Nest is usually in mature trees near water. Feeds near water, e.g., lakes, reservoirs, large ponds, freshwater marshes, shorelines (Andrew and Mosher 1982, Green 1985, Campbell et al. 1990).
Black-crowned Night Heron		Marshes, swamps, wooded streams, shores of lakes, ponds, lagoons; freshwater situations. Nests in roosts with other heron species (AOU 1983).
Great Egret		Nests are found in adjacent trees or shrubby growth, preferably on islands. Usually in colonies with other heron species. Feeds in shallow rivers, streams, ponds, lakes, marshes (Spendelov and Patton 1988).
Least Tern		Beaches, bays, estuaries, lagoons, lakes, and rivers. Rests on sandy beaches, mudflats, and dikes (AOU 1983, Stiles and Skutch 1989).
Semipalmated Sandpiper		Breeds on grassy and shrubby tundra. Nonbreeding habitat includes mudflats, sandy beaches, shores of lakes and ponds, and wet meadows (AOU 1983). In spring at Delaware Bay, consumes large numbers of horseshoe crab eggs (Castro and Myers 1993, Botton et al. 1994).
Spotted Sandpiper		Nests near freshwater in both open and wooded areas, less frequently in open grassy areas away from water; on ground in growing herbage or low shrubby growth, or against log or plant tuft (Harrison 1978). In Minnesota, successful breeders usually returned to same area to breed the next year (Reed and Oring 1993).

Focal Species	Habitat Type	Habitat - Vegetation Structure
American Woodcock	Coastal Plain and Floodplain Forests	Nests in early and mid successional forests. In Virginia, it has been known to nest in mid-aged, open growth, mixed pine-hardwood forests on lowland flood plains (Roboski and Causey 1981). Nonbreeding habitat includes upper reaches of estuaries and occasionally coastal meadows (del Hoyo et al. 1996)
Northern Oriole		Nests near the outer edge of the tree canopy. Found in open woodland, deciduous forest edge, riparian woodland, partly open situations with scattered trees, shade trees (Stiles and Skutch 1989).
Prothonotary Warbler		Breeds in mature deciduous floodplain, river, and swamp forests; wet lowland forests. In migration, habitat includes dry woodland, scrub, thickets (Bushman and Therres 1988).
Wood Thrush	Coastal Plain and Floodplain Forests	Nests in bottomlands and other wet hardwood forests. Nests usually are placed in a crotch or are saddled on a branch of a shrub, sapling, or large tree (Bertin 1977, Roth 1987, Roth et al. 1996).
Worm-eating Warbler		Nests in well-drained oak forests, oak forests along river terraces, and drier islands of nontidal forested wetlands (Stasz 1996).
Southern leopard frog		Breeds in forested and mixed grassland vernal pools and shallow waters containing submerged plant stems or sticks. Rest of year spent in nearby moist vegetation (Ryan and Winne 2001).
American Eel	Darby Creek	Catadromous: lives in freshwater; spawns in ocean. Matures in freshwater and estuarine streams and rivers. Feeds on insects, worms, crayfish and other crustaceans, and small frogs and fishes (Haro and Krueger 1991, Feunteun et al. 2003).
Alewife		Marine populations spawn in quiet portions of rivers (fresh or brackish water) or in small streams. Juveniles leave freshwater and estuarine nursery areas generally in summer or fall (Fay et al. 1983).
Blueback Herring		Spawns spawns in shallow areas covered with vegetation within freshwater or brackish, tidally influenced portions of coastal rivers (Bozeman and Van Den Avyle 1989). Juveniles emigrate from freshwater in summer or fall (Fay et al. 1983).
Striped Bass		Uses rivers, tidally influenced fresh waters, and estuaries for spawning and nursery areas (Thomson et al. 1978). Young primarily consume zooplankton and other invertebrates; adults are predatory on fish and larger crustaceans (Hassler 1988).
American Woodcock	Wet Meadows and Grasslands	Nests in early and mid successional forests. In Virginia, it has been known to nest in mid-aged, open growth, mixed pine-hardwood forests on lowland flood plains (Roboski and Causey 1981). Nonbreeding habitat includes upper reaches of estuaries and occasionally coastal meadows (del Hoyo et al. 1996)
Northern Oriole		Nests near the outer edge of the tree canopy. Found in open woodland, deciduous forest edge, riparian woodland, partly open situations with scattered trees, shade trees (Stiles and Skutch 1989).
Southern leopard frog		Breeds in forested and mixed grassland vernal pools and shallow waters containing submerged plant stems or sticks. Rest of year spent in nearby moist vegetation (Ryan and Winne 2001).

Table C.7. Priority Habitats and Their Potential Limiting Factors at John Heinz NWR.

Habitat Type	Reasons for Priority Ranking	Limiting Factors and Threats
Highest Priority Habitats		
Freshwater Tidal Marsh	Supports a globally rare and regionally endangered plant community (ranked S1/G3); supports Federal trust fish and wildlife species, State -listed endangered species as well as many other species labeled as high priority species in BCR 30 and State Wildlife Action Plan. Last intact example of unique remnant natural community in State of Pennsylvania. Supports wetlands, a Federal trust resource, and original purpose of the refuge.	Altered hydrology; water quality degradation and contamination; invasive species; sea level rise.
Coastal Plain Forest	Supports a globally rare and regionally endangered plant community (ranked S1/G3); Important habitat for species labeled as priority species in BCR 30. Supports wetlands, a Federal trust resource, and State-listed endangered species.	Excessive deer browse; invasive species;
Floodplain Forest	Important habitat for species labeled as priority species in BCR 30 and unique community (ranked S1/G3). Supports wetlands, a Federal trust resource, and State-listed endangered species.	Excessive deer browse; invasive species;
Impoundment/Open Water	Important habitat for species labeled as priority species in BCR 30 and as a foraging stopover along Atlantic flyway. Supports wetlands, a Federal trust resource, and original purpose of the refuge.	Requires intensive management and maintenance for optimal ecological benefits; invasive species; inadequate water control structure for water level manipulation
Medium Priority Habitats		
Darby Creek	Supports federally and State-listed endangered species as well as trust species. Requires little or no on-the-ground management at the refuge, but provides opportunities for protection and enhancement work with regional and watershed-based partnerships.	Degraded water quality and environmental contamination; upstream migration barriers; sea level rise
Grasslands	Isolated grassland habitat restorations provide habitat diversity and foraging habitat for landbird species, as well as provides additional habitat for State-listed amphibian and reptile species.	Succession; invasive species; requires regular maintenance

3.6 Conflicting Habitat Needs

Given the diversity of goals, purposes, mandates, and conservation priorities for the Refuge System, it is not uncommon to have conflicting management priorities at a refuge. Balancing the types and proportion of habitats (and their management) requires special consideration and process for determining the best course of action. John Heinz NWR contains habitat and management decisions that require such consideration.

Impoundment Management

The 145-acre impoundment was constructed in the early to middle part of the 20th century, while some portions of the dike system could potentially date back to the mid-17th century. The impoundment, due to its size, location, and potential for waterfowl and shorebird habitat make it the focal point of many refuge visitors. As such, this is an area that the refuge has spent considerable time and resources to determine its best use and appropriate management.

Until the past several years (since 2005), the 145-acre impoundment has largely been managed as an open water habitat for migrating and breeding waterfowl. Some tidal fluctuation occurs when water control structures allow bi-lateral flows in and out of the impoundment. There have been occasional water level drawdowns historically for maintenance purposes throughout this period. However, this type of management had limitations in its ecological benefits. Fish kills resulted from algal blooms and depleted oxygen levels. Management for waterfowl generally excluded potential benefits for other waterbirds and shorebirds. Invasive species such as purple loosestrife (*Lythrum salicaria*) and the native spatterdock (*Nuphar lutea*), have spread aggressively under the proper conditions. Control of these invasive species has largely been addressed through chemical application.

Starting in 2005, as part of their Region 3 and Region 5 Impoundment Management Study, the Service has managed the water levels within the impoundment to benefit migratory waterfowl and shorebirds. This periodic drawing down of the impoundment and the presence of mud flats have provided some of the best stopover habitat for migrating shorebirds in Pennsylvania. The area also has served as a wintering ground for over twenty species of waterfowl during this time documenting from 1,100 to 1,400 individuals per day between September and March (Green et al. 2008). This controlled water level management has also somewhat increased the prevalence of purple loosestrife, but has also increased the richness and diversity of fast-growing annual species on exposed mudflats. The potential for loosestrife colonization has been controlled with chemical application.

The results of the Region 3 and Region 5 Impoundment Management Study point to an increased diversity of plant species present and bird species utilizing the impoundment as a result of well-timed and managed water levels. Conflicting issues arise when trying to manage this 145-acre area for optimal and simultaneous use by shorebirds, waterbirds, and waterfowl. Conflicts between species can be resolved in part through timed water level management according to the migration times of various bird groups. Maintaining water levels to depths suitable for multiple groups during a given period also help reduce management conflicts between species and bird groups. Through continuing and improving this adaptive management started in recent years, the refuge can balance the needs of different species of concern within this area.

One limitation to the effective management of the impoundment appears to be the existing water control structure for the impoundment. Originally installed for periodic maintenance drawdowns, the capacity and elevation of the structure make it difficult to lower water levels quickly and to a level ideal for shorebird utilization. A secondary limitation to water level management would be the growth of invasive plant species such as purple loosestrife. If it cannot be controlled annually by chemical applications, it may require a year or two with no drawdown so it can be sprayed and then the root systems kept flooded to help control spread.

Coastal Plain, Floodplain, and Highly Altered Forests

Many of the areas surrounding the 145-acre impoundment and the freshwater tidal marsh contain floodplain forest communities. These habitats support several of the identified focal species listed as resources of

concern—mainly northern oriole, prothonotary warbler, wood thrush, worm-eating warbler, and southern leopard frog. While management of invasive species and the excessive deer browse will improve habitat conditions for all of these species of concern, conflicts arise when considering large-scale restoration projects that have potential to shift the community type present.

One area within the floodplain forest located in the southeastern portion of the refuge is dominated by an exotic gray poplar (*Populus x canescens*). This 19-acre portion of forest also contains other exotic species including wineberry (*Rubus phoenicolasius*) and the invasive annual mile-a-minute vine (*Polygonum perfoliatum*). Regeneration within this portion of forest is dominated by new sprouts of gray poplar within canopy gaps. Despite the prevalence of nonnative and invasive species, this area does provide habitat for various warbler species. Under its direction by Congress, the refuge is required to manage for biological integrity, diversity, and environmental health of the entire system. In most cases, this approach will benefit the trust resources of the Service. Occasionally, this directive conflicts with short-term wildlife needs.

Under these circumstances, the refuge ultimately will seek to restore this 19-acre area to a combination of native floodplain or coastal plain forests replicating nearby natural communities. While evaluation of site conditions (soils, hydrology, existing species coverage and utilization), is necessary before large-scale restoration is undertaken, several other considerations will likely be made to balance current habitat needs with long-term ecosystem goals. To the extent feasible, the refuge can undertake a phased approach to removal of the exotic gray poplar and associated invasive species during off-peak utilization periods (ie. winter, summer). Phased clearing and planting will limit the amount of immediate habitat lost, while working toward long-term restoration goals. A full evaluation of species utilization and restoration options will be necessary prior to starting restoration efforts.

Another location where floodplain forest restoration may conflict with habitat management is in the degraded floodplain forest located adjacent to State Road 420 and Darby Creek in the eastern portions of the refuge. Approximately 57 acres of floodplain forest dominated by silver maple (*Acer saccharinum*), boxelder (*Acer negundo*), American elm (*Ulmus americana*), and eastern cottonwood (*Populus deltoides*) are located in this area. These communities were noted in the Lower Darby Restoration Management Plan (2005) as being severely degraded habitats due to excessive deer browse and invasive species, and the plan recommended a portion of this area be restored to freshwater tidal marsh. Historically, this area was freshwater tidal marsh until the early 1970s when the interchange for State Road 420 and Interstate 95 was constructed. The “Two Studies of Tinicum Marsh” documents the vegetation that was present in this area just prior to its alteration (McCormick et al. 1970).

Restoration of a portion of this area could pose a conflict between the management of species utilizing the floodplain forest habitat with those that would benefit from additional freshwater tidal marsh. When comparing habitat types, the number and types of species that would benefit from additional freshwater tidal marsh greatly outnumber those that utilize floodplain forests. Restoration of this site should utilize a combination of data from reference marsh vegetation, hydrology, and elevation, and channel morphology to restore a healthy and intact marsh. Some floodplain forest will likely need to remain due to existing pipeline right-of-ways and as sound and visual barriers. A preliminary estimate of the site indicates that up to 35 acres of freshwater tidal marsh could be restored in this area.

3.7 Adaptive Management

The priority resources of concern and their respective habitat attributes were used to develop specific habitat objectives. Refuge habitat management objectives must be achievable. Many factors, such as the lack of resources, existing habitat conditions, species response to habitat manipulations, climatic changes, and contaminants or invasive species, may reduce or eliminate the ability of the refuge to achieve objectives. Although these limiting factors were considered during the development of management objectives, conditions are likely to change over the next 15 years and beyond. The refuge will use adaptive management to respond to changing conditions that impair our ability to measure and achieve the habitat objectives. That will require the refuge to establish and maintain a monitoring program to ensure that changing conditions can be detected and responded to adequately and efficiently. The monitoring program will be developed in accordance with 701 FW 2 as a step-down plan.

Chapter 4. Habitat Goals and Objectives

4.1 Background

4.2 Habitat Goals and Objectives

4.1 Background

The goals and objectives in this chapter were developed through collaboration among managers and biologists from John Heinz NWR and Region 5 of the Service. Prior to their development, John Heinz NWR staff and planners solicited input from a variety of government and nonprofit conservation organizations including the Service's Delaware Bay Ecological Services, NOAA Fisheries staff, USDA APHIS-WS, Friends of the John Heinz Refuge, Partnership for the Delaware Estuary, and Delaware Riverkeeper Network. The goals written here are broad so that they may be incorporated into the CCP, which we began to draft in 2010. These goals and objectives will be reevaluated during the CCP process with additional public, State, university, and nongovernmental organization involvement. To develop habitat objectives, refuge staff conducted a comprehensive analysis of habitat requirements for each priority resource of concern (table C.5). To facilitate management, all priority resources of concern were grouped into habitat types, and further investigated reviewing limiting factors and threats to each habitat type (table C.6).

The Service requires habitat objectives be developed using the SMART criteria, specifically that objectives be Specific, Measurable, Achievable, Result-oriented, and Time-fixed. A rationale is provided for each habitat objective in order to summarize the scientific information, expert opinion, and professional judgment used to formulate each objective.

4.2 Habitat Goals and Objectives

GOAL 1 Protect, maintain, and restore where possible, the biological integrity, diversity, and environmental health of southeastern Pennsylvania coastal plain ecological communities that are unique to the refuge and sustain native plants and wildlife, including species of conservation concern.

Objective 1.1 Freshwater Tidal Marsh

Protect the existing 282 acres and restore or acquire an additional 173 acres of freshwater tidal marsh communities throughout the refuge within the next 15 years. Restored marsh would be dominated by native marsh vegetation including, but not limited to, wild rice (*Zizia aquatica*), spatterdock (*Nuphar lutea*), pickerelweed (*Pontederia cordata*), and tick-seed sunflower (*Bidens spp.*). Restored marshes will reestablish greater than 80 percent coverage of native marsh plant species and tidal hydrology that inundates greater than 90 percent of the marsh plain surface with shallow water (less than 1-foot maximum depth) at mean high tide and results in the development of natural channels across the marsh plain surface.

Rationale

The Pennsylvania Natural Heritage Program estimates that Philadelphia County at one time contained up to 10 to 20 square miles (6,400–12,800 acres) of freshwater tidal marsh. As it is today, historically, these wetlands provided an important breeding spot for many bird, mammal, fish, and insect species. It was also a critical stopover site for migratory waterfowl and shorebirds during their annual migrations. Today, John Heinz NWR protects the 1/3 square mile of freshwater tidal marsh that remains in this part of the State (PNHP 2008). Freshwater tidal marshes are some of the most biologically productive ecosystems in the world because they contain high plant diversity and support more bird use than any other wetland type (Mitch and Gosselink 1993). Coastal marshes (including freshwater tidal marshes) are among the highest priority habitats within BCR 30 due to pressures, rates of loss, or lack of information on present spatial distribution (USFWS 2008).

Although this remnant area of freshwater tidal marsh has been severely impacted over the years, it still supports a variety of species unique to the surrounding landscape and region. Nine of the 22 priority species of concern are primarily associated with this habitat type. At least another 8 of the 22 also utilize the marsh habitat. Vegetation structure, microhabitat conditions (elevations relative to mean high tide, presence of small channels across the marsh plain, occasional shrubs or small trees), and landscape context (surrounding land

use, size, and contiguousness) are more critical habitat components for species of concern, rather than specific plant species. However, the presence of high marsh, that is, portions of marsh that are at the upper extent of the high tide fluctuation and subject to shorter durations of inundation tend to support a greater variety of plant species and suitable nesting sites for species such as American bittern, least bittern, king rail, and marsh rice rat.

Due to recent reports on the effects of climate change, monitoring freshwater tidal and other coastal marshes is considered to be of high importance for their long-term conservation (USFWS 2008). Due to the unique landscape context of the refuge (within the Philadelphia metropolitan area, within a highly urbanized watershed, at the confluence of Darby Creek and the Delaware River, less than 1 mile upstream from the river's salt line) areas of freshwater tidal marsh are particularly vulnerable to changing sea levels. Alteration in the balance of marsh elevations, sediment accretion rates, sea levels, and salinity can potentially have major impacts on the existing marsh area. At this time, it is unclear to what extent sea levels will rise and how it might affect the refuge (UCS 2008). Due to this uncertainty, the refuge needs to create a marsh monitoring program to document and evaluate local trends in sedimentation rates, vegetative cover and species composition, as well as changes in percent of marsh surface as open water at low tide.

Two rare species listed as Pennsylvania-extirpated include the marsh rice rat and the eastern mud turtle. The eastern mud turtle has been identified at the refuge, but has not been confirmed by the Pennsylvania Natural Heritage Program. The marsh rice rat is believed to be extirpated from Pennsylvania (PNHP 2008). However, the freshwater tidal marsh at John Heinz NWR is the last potential habitat for this secretive small mammal. A series of presence or absence surveys throughout the marsh would provide data necessary to confirm the species presence within the State as well as its inclusion as a resource of concern for the refuge.

Chapter 3 documents the many impacts that have altered the extent and quality of freshwater tidal marsh existing today on the refuge. The Restoration Management Plan for Lower Darby Creek documented and mapped areas of historic tidal marsh that have been severely altered and their approximate date of impact (Salas et al. 2006). Some of these areas are suitable locations for restoration of tidal marsh habitat. Refuge staff has recently completed excavation work associated with restoration of tidal marsh to approximately 10 acres of land previously dominated by *Phragmites australis*.

Areas of freshwater tidal marsh less impacted by dredge and fill activities have been impacted by exotic, invasive species introductions. About 60 acres of tidal marsh are currently dominated by *Phragmites australis*. Many of these populations are smaller than 0.5 acres in size. Marsh vegetation and elevation surveys completed in 2005 documented the correlation between marsh plain elevations and species composition. *Phragmites* were found to generally inhabit the same zone as the highly diverse, Freshwater Tidal Mixed Forbs High Marsh ecological community component of the freshwater tidal marsh habitat. These areas of high marsh provide the most suitable nesting habitats for waterbirds associated with this habitat type.

Objective 1.2 Coastal Plain and Floodplain Forests

Over the next 15 years, acquire or restore up to 18 acres of coastal plain and floodplain forest, and manage the existing 34 acres of coastal plain forest and 261 acres of floodplain forest communities. These communities will provide healthy foraging and stopover habitat for migratory bird species and provide breeding habitat for the southern leopard frog by: maintaining a canopy dominated by native trees, increasing native understory shrub and sapling cover by 10 percent, and at least a 15 percent reduction in areal coverage of herbaceous, invasive species as compared to levels inventoried in 2005. Also, we will restore at least 7.7 acres of existing cool-season grass meadows to at least 50 percent cover by native shrub or early successional coastal plain forest species near the 10-acre marsh restoration site and an additional 0.6 acres within the grasslands restored as part of the oil spill wetland mitigation site.

Rationale

Coastal plain and floodplain forests provide important habitat for migrating passerine species. The Mid-Atlantic Coastal Plain in Pennsylvania was historically found only in a 1 to 5 mile-wide strip along the lower 50 miles

of the State's Delaware River frontage. The coastal plain and floodplain forest types covered a significant portion of Philadelphia, supporting a suite of species common to forests further south (PNHP 2008). Focal species of concern identified for this habitat (northern oriole, prothonotary warbler, wood thrush, and worm-eating warbler), other associated species such as the Swainson's warbler, cerulean warbler, Kentucky warbler, Acadian flycatcher, and yellow-throated vireo, are all primarily associated with forested wetlands and have high concern scores within the Mid-Atlantic Coastal Plain (PIF 1999).

The prothonotary warbler and other landbirds utilize mature deciduous floodplain, riverine, and swamp forests primarily for migratory stopover and foraging habitat at the refuge (DeGraaf et al. 1980, Christman 1984). Although this species will utilize the drier portion of the forested wetland gradient, flooded habitats have been shown elsewhere to be preferred and of higher quality (Petit and Petit 1996). Prothonotary warblers are secondary cavity nesters and a good indicator species for permanently flooded forested wetlands. Prothonotary warblers are widespread throughout the extensive swamps and riverine forested wetlands within the Mid-Atlantic region (PIF 1999). However, these habitats are largely unrepresented in this portion of Pennsylvania and along the Delaware River.

Regional conservation plans developed by Partners in Flight and the Atlantic Coast Joint Venture both emphasize the need for inventory and monitoring of nesting sites for forested wetland nesting species such as prothonotary warbler, wood thrush, and worm-eating warbler. While these species generally utilize the forest of John Heinz NWR for migratory stopover habitat, other species associated primarily with other habitats sometimes utilize forested areas for forage and nest sites. For example, bald eagles (primarily associated with the impoundment and Darby Creek) require forested areas for nesting sites. The short-eared owl (associated primarily with freshwater tidal marsh) is also known to nest in portions of the coastal and floodplain forests of John Heinz NWR. To better guide forest management at John Heinz NWR, an inventory of existing nesting sites and conditions will provide information to prevent potential damage to nest sites during restoration activities and enhance opportunities in other areas not yet suitable.

Most invasive plants reduce the availability and quality of native habitats, and these can have major impacts on priority bird species (USFWS 2008). The Restoration Management Plan for Lower Darby Creek documented extensive invasive species populations within the coastal plain and floodplain forest ecosystems. Multiflora rose (*Rosa multiflora*), garlic mustard (*Alliaria petiolata*), Japanese honeysuckle (*Lonicera japonica*), Japanese stiltgrass (*Microstegium vimineum*), and mile-a-minute vine (*Polygonum perfoliatum*) are the most common invasive plant species found throughout forested habitats (Salas et al. 2006). An abundance of invasive species can result in reduced biodiversity and poor habitat quality. Some herbaceous and vine species (including garlic mustard, Japanese honeysuckle, Japanese stiltgrass, and mile-a-minute vine) can dominate the forest understory and prevent or inhibit tree and shrub regeneration. Many floodplain forest restoration projects in and around the Delaware Valley have resulted in significant degradation or loss as a result of competition with exotic, invasive species (PNHP 2008). Oriental bittersweet, Japanese hops, Japanese knotweed, Chinese wisteria, and bush honeysuckle are also major invasive species in this habitat at John Heinz NWR. In a few cases, some native birds of concern, including northern saw-whet owls, have benefited from the cover provided by entanglements of invasive vines, such as Oriental bittersweet (*Celastrus orbiculatus*) and Japanese honeysuckle (*Lonicera japonica*).

One of the most critical habitat components within forested ecosystems is a well-developed forest structure including canopy trees, sub-canopy trees, understory shrubs, and a diverse ground cover. These structural components provide numerous feeding opportunities as well as protective cover to escape predation. Much of this natural structure has been severely altered within John Heinz NWR as a result of excessive deer browse, as documented in the Restoration Management Plan for Lower Darby Creek (Salas et al. 2006). The impacts of deer on forest ecosystems and their habitat components has been well documented, including their status, trend, and impact within Pennsylvania (Latham et al. 2005). Long-term preservation of nesting habitat, conservation of high-quality habitat, and restoration of degraded areas will not be feasible with continued impacts of an unsustainable deer population.

Reduction of plant species diversity and richness is a commonly noted effect of deer overpopulation. On long affected sites, the establishment and dominance of browse resilient species often is the result. Consequently, deer browse can have a measured effect on the balance between native and introduced species. Studies have repeatedly shown that deer avoid invasive species such as garlic mustard, Eurasian honeysuckle (*Lonicera spp.*), Japanese barberry (*Berberis japonica*), and tree-of-heaven (*Ailanthus altissima*) if other sources of food are available (Latham et al. 2005). Deer abundance also alters ecosystem structure by reducing densities of understory trees and eliminating shrubs. Research in central Pennsylvania indicated that the occurrence of canopy gaps increased by 41 percent on lands where deer control efforts were prohibited as compared to State lands where control efforts were undertaken (Pederson and Wallis 2004).

The adverse effects of excessive deer browse are not limited to plant species. It can also alter ecosystems to the extent that they become unfavorable habitats for other wildlife. Gray squirrel, white-footed mouse, and some amphibian species have been shown to decline in areas highly browsed by deer (Elliot 1978; Nixon and Hanson 1987). Subsequently, predators of these species, owls, hawks and other carnivores, decline (Flowerdew and Elwood 2001). At a site in Virginia, a reduction in forest species densities also leads to increased nest predation and lower bird abundance (Leimgruber et al. 1994). These results were reinforced by a study of songbird/deer population relationships in British Columbia that found a 93 percent decrease in bird species dependent on understory vegetation (Allombert et al. 2005).

Refuge biologists have been conducting deer population inventories for more than 5 years. These surveys involve counting deer that are collectively driven systematically from various portions of the refuge. Although this method does have potential for error, such as omitting or double counting individuals (McCullough 2001), the results of these surveys have consistently recorded population numbers in the range of 200 to 240 deer per square mile. By comparison, a deer and songbird population relationship study in northwestern Pennsylvania concluded that the threshold level for negative effects on songbird richness was between 20 and 38 deer per square mile (deCalesta 1994).

Refuge biologists have completed a draft deer management plan in partnership with the USDA's Division of Wildlife Services. This plan will inventory and evaluate the level of deer browse pressure on the refuge habitats and develop a population management plan based on measurable results from browse surveys and vegetation transects. This plan will guide deer management based on its actual on-the-ground impacts to refuge habitats, rather than attempting to achieve an arbitrary density measurement (e.g., deer per square mile or set number of individuals) (D'Angelo and Stolz, personal communication, 2008).

As part of the deer management plan, fenced vegetation plots that exclude white-tailed deer will be incorporated into monitoring. These plots will be used to gauge the potential for natural forest regeneration when browsing by deer is suppressed. Fenced plots will be paired with nearby unfenced plots. Forest regeneration will be deemed within acceptable limits when the number and viability of individuals of desired plant species in unfenced plots is at least 50 percent of fenced plots (D'Angelo personal communication 2009).

Highly altered forests of the refuge consist of existing forested habitats that either have not been completely inventoried to understand and delineate their NVCS community types due to access restrictions (in the case of Folcroft Landfill) or contain substantial variation from natural forest communities typical of the refuge and surrounding region. Management of these habitats focuses on inventory and identification of resources as well as restoration of areas where the need has been identified. As discussed in the prior section, the forests of the refuge are relatively young ecosystems having only been present for the past 20 to 30 years.

This early successional development to forest has led to the development of many coastal plain and floodplain forests typical of the Philadelphia area in most areas. One 19-acre area in particular has resulted in a forest dominated by the fast growing, exotic gray poplar. This portion of forest also contains other exotic species including wineberry (*Rubus phoenicolasius*) and the invasive annual mile-a-minute vine (*Polygonum perfoliatum*). Regeneration within this portion of forest is dominated by new sprouts of gray poplar within canopy gaps. Despite the prevalence of nonnative and invasive species, this area does provide habitat utilized by short-eared owls (a focal resource of concern, a Pennsylvania endangered species, and Service trust species) for nesting as well as various warbler species.

Evaluation of site conditions (soils, hydrology, existing species coverage and utilization), will be necessary before large-scale restoration is undertaken. Considerations will need to be made to balance current habitat needs with long-term ecosystem goals related to nesting priority species of concern within this area. To the extent feasible, the refuge can undertake a phased approach to the removal of the exotic gray poplar and associated invasive species during off-peak utilization periods (i.e., winter and summer). Phased clearing and planting will limit the amount of immediate habitat lost, while working toward long-term restoration goals.

Objective 1.3 Darby Creek

Over the next 15 years, manage inputs to Darby Creek on the refuge to reduce contaminants, reduce stormwater impacts from the refuge, and provide spawning, nursery, foraging, and cover habitat for anadromous and catadromous fish populations and Federal trust fish and wildlife species, including American eel, striped bass, blueback herring, and alewife.

Rationale

Tidal portions of Darby Creek, in combination with freshwater tidal marsh, provide a unique and productive habitat for many fish species. Some estuarine species, such as killifishes and mummichogs (*Fundulus* spp.) complete their entire life cycle in estuarine portions of rivers, creek, and tidal marshes. Anadromous fish, such as the blueback herring and alewife, tidal streams, and rivers like Darby Creek and its side channels provide nursery habitat for juveniles (Odum et al. 1984). American eel, the only catadromous fish species in Atlantic Coast estuaries, spends most of its adult life in freshwater estuaries and are common in tidal creeks, rivers, and marsh channels (Lippson et al. 1979). Thus, improving water quality and restoring suitable channel morphology where possible is critical to maintaining healthy BIDEH parameters that support fish species.

The National Fish Habitat Action Plan outlines several management strategies that can help guide aquatic habitat management on the refuge, as well as connecting habitats both up and downstream. Restoration efforts by local and regional organizations within the Darby Creek watershed support components of Strategy 2 (Restoring natural flow and habitat variability to streams and rivers). Dam removal and other fish barrier removal efforts along Darby Creek support Strategy 3 (Reconnecting fragmented river systems and spawning and nursery habitats). While these efforts are mainly located beyond the boundaries of John Heinz NWR, Strategy 3 can be supported at the refuge by freshwater tidal marsh restoration efforts that incorporate the development of shallow, sinuous, marsh surface channels that support spawning and nursery habitat for estuarine and freshwater fish species.

Water quality in the refuge is a highly variable and complex phenomenon resulting from inputs of three major streams: Darby Creek, Cobbs Creek (a major tributary to the Darby), and the Delaware River. The contribution from each of these sources at any given time varies depending upon tidal, hydrological, climatological, and anthropogenic conditions. The refuge is fortunate in that a number of reports have been produced recently that describe and summarize the status of the Darby Creek watershed based on recent data including the Darby Creek Rivers Conservation Plan (DCVA 2005), Lower Darby Creek Area 33 USEPA Facility Report (NOAA 2000), and PWD's Darby-Cobbs Characterization Report (PWD 2002).

The Darby Creek watershed has numerous problems, most of which can be characterized as being derived from excessive urbanization. Cobbs Creek, a major tributary of Darby Creek has been found to be an area of significantly lower quality than Darby Creek (DCVA 2005). Urbanization has resulted in large amounts of impervious surface, which in turn is impacting the refuge through increasing stormwater runoff, introducing various toxic metals, resulting in algal-related impacts on in-stream oxygen resources, de-stabilizing stream banks, impairing and decreasing biological habitats, and decreasing stream base flows.

These impairments cause biological impacts. Fish data indicate that Darby Creek has greater species diversity including some pollution intolerant species. Biometric scores suggest that the downstream reach of Darby Creek is "good," although upstream locations were "fair" or "poor." Cobbs Creek fish metrics indicate only "fair" or "poor" (PWD 2002). Research completed by the Service in 2004 found a significantly higher number (26 percent) of liver tumors and skin lesions in brown bullheads (*Ameiurus nebulosus*) collected

from Darby Creek, as compared to those collected from nearby reference sites. The suspected source of this contamination is elevated levels of Polycyclic aromatic hydrocarbons (PAHs) in Darby Creek. According to the study authors, the USEPA has identified 19 significant disposal or fill sites adjacent to Darby Creek from 1953 to 1983, including many sites that should still be considered significant potential sources of PAHs to Darby Creek (Pinkney et al. 2004).

The Folcroft Landfill, which became part of the refuge in 1980, is part of the Lower Darby Creek Area Superfund Site, which also includes the Clearview Landfill, located just upstream of the refuge, and four other sites within a 2-mile stretch along Darby Creek (NOAA 2000). Coordination with the USEPA regarding contaminant remediation is ongoing. As a result, no restoration activities for the Folcroft Landfill are proposed in this plan. Ecological restoration plans will need to be coordinated with the USEPA upon remediation of the contamination.

Due to the complexity and regional-scale of these water quality impacts, there is unfortunately little that can be done to alleviate these concerns through management on the refuge. However, the refuge can play an active role in coordination and technical assistance toward efforts that result in improved water quality on the refuge. The geographic location of the refuge at the base of the Darby Creek watershed and near the Delaware River make it an ideal location for bringing together all parties involved in protection and restoration efforts.

GOAL 2 Contribute to the enhancement of native species diversity in the Delaware Estuary, including migratory birds and other species of conservation concern, within the refuge's managed open waters and grasslands.

Objective 2.1 Impoundment and Nontidal Open Water

Restore about half (78 acres) of the 145-acre impoundment to freshwater tidal marsh and manage the remaining 66.6-acre impoundment and 56.4-acres of nontidal open water to enhance habitat available for shorebirds, waterfowl, and wading birds during their peak spring and fall migration periods while maintaining essential habitat for other freshwater species of management concern, such as red-bellied turtles, through a combination of water level management, wetland restoration, and invasive species control.

To the extent practicable, these measures will include the following:

1. Annually support migratory shorebirds through a mix of shallow water (less than 6 inches water depth), mudflat with sparse vegetation (less than 10 percent cover), and mudflats with no vegetation, at times of peak migration (spring: May, and fall: mid-August through September).
2. Annually support migratory waterfowl through a mix of shallow (6 to 24 inches water depth) flooded vegetation (*Carex* spp., *Polygonum* spp., *Peltandra* spp.) at times of peak migration (spring: late March, and fall: late October).
3. Annually support migratory wading birds through a mix of shallow remnant pools (6 to 12 inches water depth) at times of peak migration (spring: late March, and fall: late August).
4. Sustain State-threatened eastern redbelly turtle through protection of hibernation, foraging, basking, and nesting habitat.

Rationale

Dikes around the refuge are believed to have been built as early as the 1640s by either the Swedes or the Dutch in order to create areas suitable for agriculture. The 145-acre impoundment as we know it today was likely constructed sometime during the 1940s or 1950s. The periodic drawing down of the impoundment and the presence of tidal mud flats provide some of the best stopover habitat for migrating shorebirds in

Pennsylvania (Cohen and Johnson 2004). In addition, many waterfowl, wading birds, waterbirds, and landbirds utilize the impoundment as well. The area serves as a wintering ground for over 20 species of waterfowl with 1,100 to 1,400 individuals per day between September and March (Green et al. 2008).

Historically, the impoundment was fed by a combination of groundwater and diversions from Darby Creek and managed as open water with periodic tidal fluctuation. Two former water control structures are still in place along portions of the impoundment dike. However, these structures became unusable as Darby Creek's channel pattern shifted further away from the dike in these locations during the early 1980s—causing the structures to become silted in. Today, the refuge contains an active water control structure in the northeast corner of the impoundment. Over the past several years, the Service has managed the water levels within the impoundment to benefit migratory waterfowl, wading birds, and shorebirds with successful results (Green et al. 2008; Phillips personal communication 2008).

This recent management was completed in conjunction with 23 other national wildlife refuges across the Service's Regions 3 and 5 as part of a 3-year management experiment. Management prescriptions for the timing of water manipulation in impoundments involved drawdowns to coincide with either spring or fall shorebird migration. The effects of this timing on waterbird communities, invertebrate communities, and vegetation communities, throughout the annual wetland cycle, were monitored. In addition to evaluating the effects of traditional habitat management practices on attaining objectives for a suite of trust species, this study provides monitoring protocols, databases, and analytical methods that can be used by refuge staff after the study ends for adaptive management of their impoundments (Lyons et al. 2005).

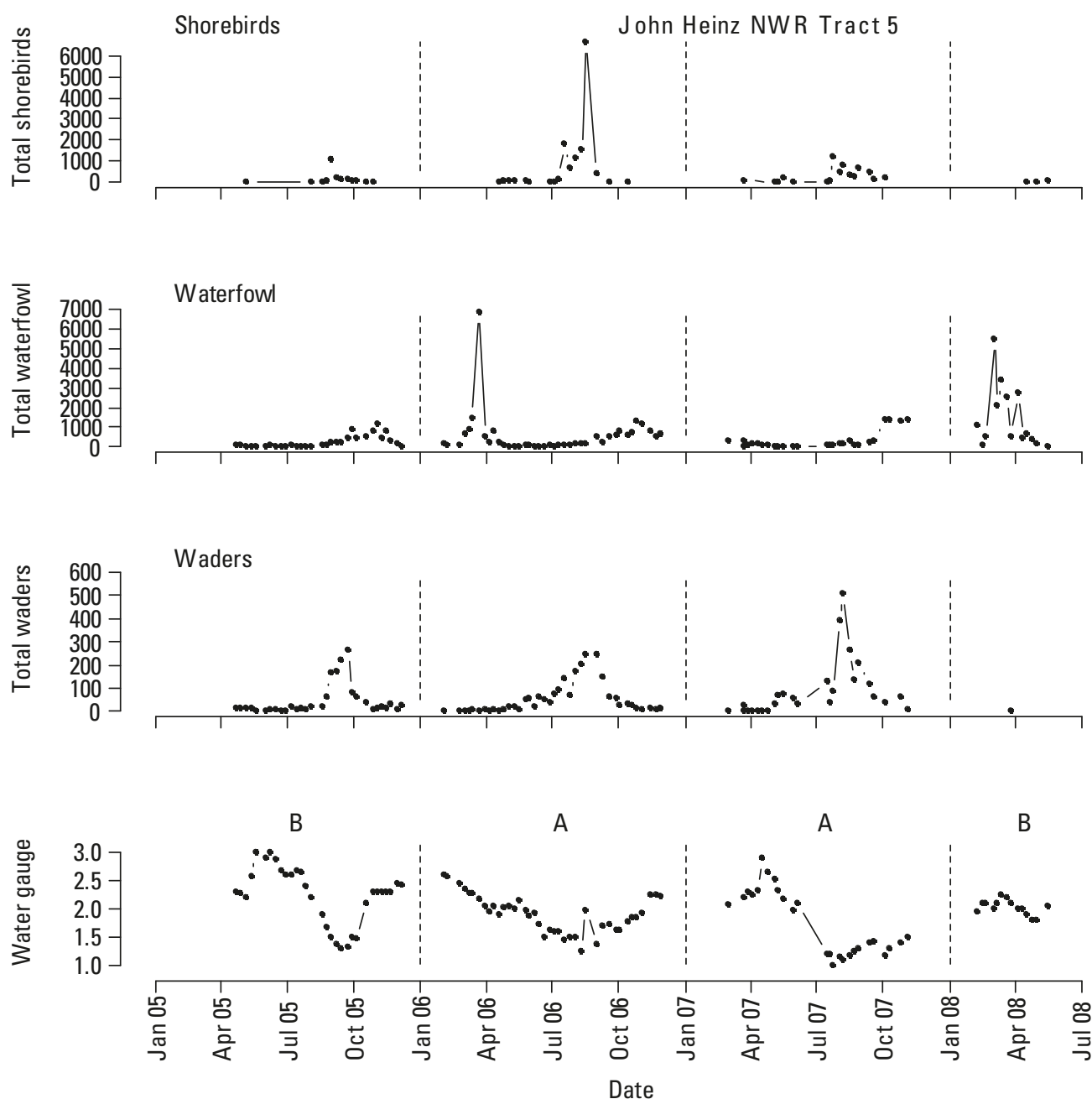
The impoundment study results are completed in draft form at the time of this writing. At this time, it appears that the timed management developed as part of the study has been successful in supporting diverse bird population use of the impoundment area (Green et al. 2008; Phillips personal communication 2008). Draft results indicate that this management should be continued.

These timed drawdowns are focused on providing the most optimal habitat available within the impoundment for various bird groups during their peak migration stopovers in both the spring and fall (figure C.4). The results of this study indicate that the following variations in mean water levels and vegetation composition provide the most benefits for migrating groups. The impoundment area also provides secondary and hibernation habitat use by the State-listed endangered turtle species generally associated with the freshwater tidal marsh and Darby Creek (Stolz personal communication 2005). Management considerations must be made to sustain the use by and protection of these nonbird focal species as well.

Table C.8. Bird Groups and Optimal Conditions for Migratory Stopover and Forage Enhancement within the Impoundment (Based on Results of the Region 3 and Region 5 Impoundment Study).

Bird Groups	Water Depth (inches)	Vegetation Composition and Areal Coverage	Time of Year
Shorebirds	0.0 – 6.0	Mudflats containing less than 10 percent vegetative cover.	Spring: May Fall: Mid-August to September
Waterfowl	6.0 – 24.0	Less than 10 percent cover of shallow marsh and emergent aquatic species (including <i>Carex</i> , <i>Polygonum</i> , and <i>Peltandra</i>)	Spring: Late March Fall: Late October
Wading Birds	6.0 – 12.0	Open water containing less than 10 percent vegetative cover.	Spring: Late March Fall: Late August

Figure C.4. Shorebird, waterfowl, and wader abundance (adjusted for partial observability) and water gauge levels within the 145-acre impoundment at John Heinz NWR (from Green et al. 2008).



Management of the impoundment requires an adaptive approach to reduce, control, or eliminate undesirable plant species such as the invasive, exotic purple loosestrife and the aggressive, native spatterdock, while at the same time promoting the germination of seed producing vegetation such as smartweeds and mudflats for benthic invertebrates. In some years, it is anticipated that the annual water level management objectives

will likely require some variation from the timing most adaptable for migratory birds. To maintain extensive mudflats, annual vegetation, and shallow pools, the impoundment will occasionally require extensive inundation to prevent long-term establishment of perennial invasive species, such as purple loosestrife. Extended inundation periods should be employed when the presence of invasive species becomes larger than feasible for control through herbicide applications. The threshold for this type of management action would be when the impoundment begins to support approximately 10 acres (7 percent) coverage of a nearly monotypic population of invasive exotic species.

Prior to construction, the lands inundated by the 145-acre impoundment were historically freshwater tidal marsh, and there is some question about how much impact the water level management has on actual bird population versus perceived populations.. While the three-year impoundment study did indicate an increase in bird populations within the impoundment during migration, there were no corresponding control surveys conducted within the adjacent freshwater tidal marsh (Phillips personal communication 2010). The increase in use observed may actually be the result of birds favoring the impoundment over use of the freshwater tidal marsh during the drawdowns, which will cause a corresponding decrease within the freshwater tidal marsh. The impoundment also provides habitat for other species of conservation concern, for example the State-listed eastern redbelly turtle. However, the Restoration Management Plan for Lower Darby Creek outlined portions of the impoundment for potential tidal marsh restoration opportunities. For these reasons, refuge staff is interested in evaluating potential benefits and adverse effects of restoring of a portion of the impoundment to freshwater tidal marsh (Stolz and Woodward personal communication 2009).

It is possible that nonnative invasive aquatic crayfishes, which represent a significant threat to the refuge's aquatic systems, occur within the refuge (Urban 2012 personal communication). Management actions, including the removal of dams and other blockages may cause the dispersal of nonnative crayfishes, potentially allowing them to invade new areas. Therefore, we will complete a survey and analysis of both tidal marsh and impoundment habitats to better inform the extent and location of any marsh restoration within the impoundment.

Objective 2.2 Wet Meadows, Grasslands, and Early Successional Habitats

Manage up to 64 acres to create a mix of native grasses and flowering plants, within components including early successional shrubs and trees to sustain stopover foraging and cover for migratory landbirds. Specifically,

1. Annually, manage habitat around Frog Pond and Hoy's Pond fringe as native-species dominated wet meadow to contain less than 15 percent areal coverage of tree and shrub species, and no greater than 5 percent bare ground, and so that at least 90 percent of the total areal cover is comprised of native species.
2. Within 10 years of plan approval, restore biological diversity to the existing 7.1 acres of grasslands surrounding the visitor center and refuge entrance, so that at least 90 percent of the total areal cover is comprised of native species and support a minimum of 7 species of native grasses, and 7 species of native flowering plants.

Rationale

Fewer grasslands are available to birds throughout the Mid-Atlantic region as agricultural lands have been lost to commercial and residential development as well as natural succession. Today, grassland dependent birds within the Mid-Atlantic region depend upon agricultural landscapes and other artificial habitats to maintain populations. Military installations, airports, golf courses, parks, recreational fields and other man-made and maintained grasslands provide some modified types of this habitat today. The New England and Mid-Atlantic Coast BCR 30 recommends that opportunities to affect large grassland communities should be implemented, when practical (USFWS 2008).

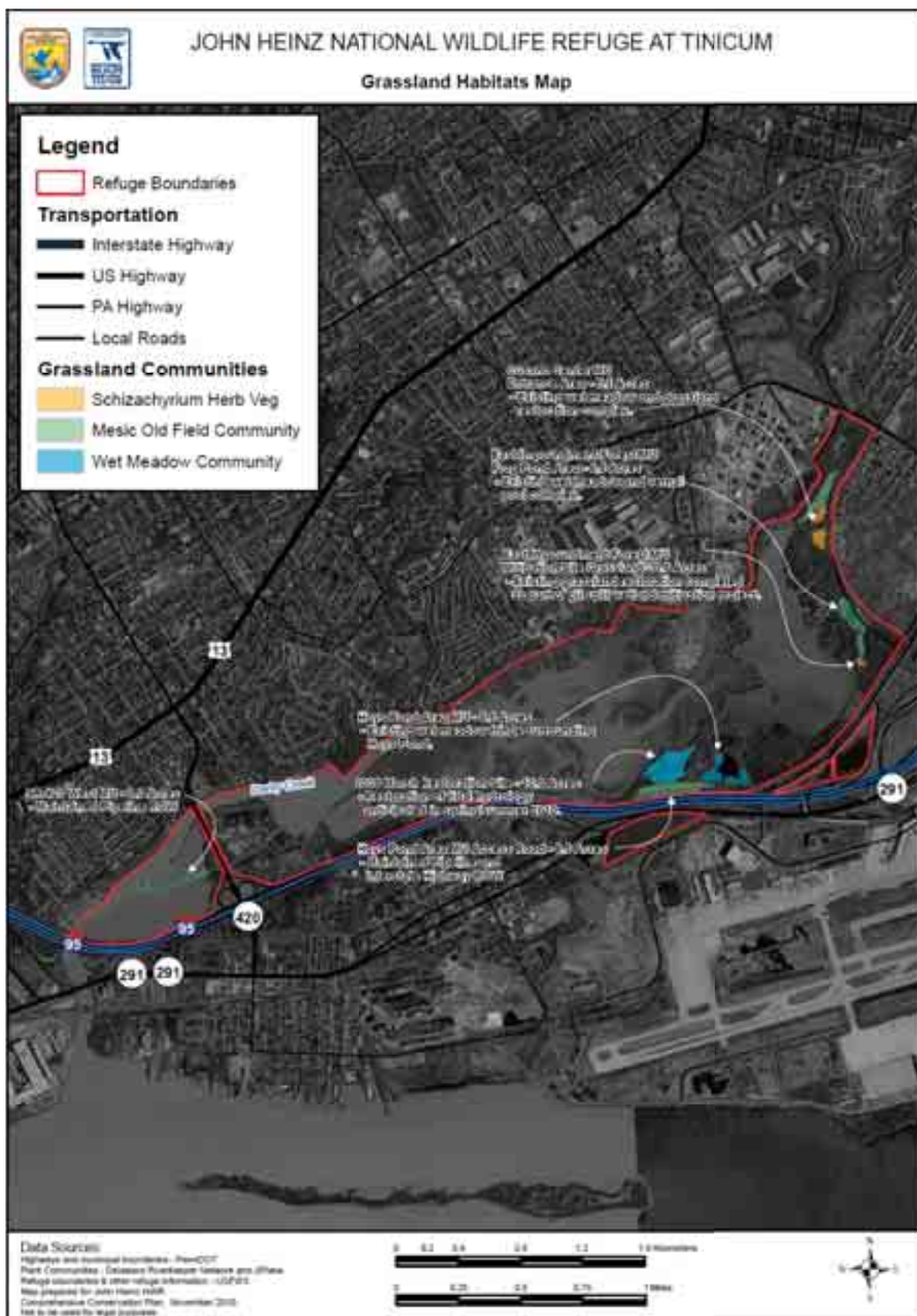
Grasslands and native meadows likely covered a substantial proportion of the Philadelphia area prior to European colonization. It is unlikely that these were self-sustaining ecosystems in this area. There is extensive evidence that meadows were managed by resident Native Americans who burned them on a periodic basis to prevent their succession back to forest and provide foraging areas for game species such as grouse, turkey, deer, and elk (Latham et al. 2005). These systems supported plant species that are generally common to the extensive grasslands found in Midwestern States despite their diminutive size. As availability of grassland habitats has decreased, these species have experienced population declines and are now considered among the most threatened species within the Mid-Atlantic region (PIF 1999). Several remnant native meadows exist within Philadelphia with active restoration plans. Active management of these areas typically includes the removal of nonnative invasive species, replanting of lost native species, and control of woody species (PNHP 2008).

Until the past few decades, the upland habitats of the refuge were comprised of a substantially greater amount of grasslands than today (McCormick et al. 1970; McMennamin personal communication 2008). The Restoration Management Plan for Lower Darby Creek compared habitat coverages between those documented in the Two Studies of Tinicum Marsh and those identified as part of field inventories conducted in 2005. Many forested areas along the existing dike system and within areas east and south of the 145-acre impoundment contained scattered trees (less than 10 percent cover) and “old field” vegetation in 1968, making the forested habitats of the refuge a relatively recent cover type (Salas et al. 2006).

While the grasslands of John Heinz NWR are generally too small to support nesting of priority grassland species within the region (see map C.4), some grassland areas can provide suitable migratory support habitat. Additionally, these grasslands provide important habitat for focal species of concern such as the short-eared owl, sedge wren, marsh wren, and the southern leopard frog. The southern leopard frog in particular is known to breed in some of the shallow permanent water and vernal pool habitats found within wet meadow grasslands (Phillips and McMennamin, personal communication 2008).

Despite these benefits, grasslands, being an early successional community type, require significant maintenance and time inputs to be maintained over a long-term period. In some areas, it will be more economically and ecologically beneficial to manage existing grassland habitats in a successional trajectory toward coastal or floodplain forest. Each individual grassland patch will require evaluation based on existing and potential habitat benefits, educational and research value, regulatory requirements (in the case of utility and highway right-of-ways), as well as aesthetic and visitor service goals for grasslands found near the refuge entrance and visitor center. An overview of the grasslands of John Heinz NWR is provided in figure 4.1. Management Units used to describe locations are specified in section 5.1.

Map C.4. Existing Grassland Habitats at John Heinz NWR



Chapter 5. Management Strategies and Prescriptions

5.1 Development of Management Strategies and Prescriptions

5.2 Management Units

5.3 Management Strategies and Prescriptions by Habitat Objective

5.1 Development of Management Strategies and Prescriptions

This chapter outlines management strategies and prescriptions to address the habitat management goals and objectives outlined in chapter 4. Management strategies identify the tools and techniques (e.g., mowing, water level manipulation, chemical application, etc.) utilized to achieve the habitat objectives. Prescriptions provide the details behind the specific means by which the strategies will be implemented (e.g., timing, frequency, duration, and location). A review of available literature related to potential strategies and prescription was incorporated during their development. The identified treatments were selected in consultation with other refuge biologists, managers, and practitioners to ensure their effectiveness. Many environmental factors including wildlife populations, weather, seasonal variations, and habitat conditions affect the selected prescriptions and their ability to achieve objectives from year to year. As such, many of the details of prescriptions will be identified in the annual habitat work plan. Prescriptions outlined herein are discussed on a conceptual level.

The natural world contains a myriad of extremely complex and dynamic systems. This is especially true in biological refuges such as John Heinz NWR, which contain an array of different habitats that support hundreds of plant, fish, and wildlife species in a relatively small area. It is important to understand as land stewards and habitat managers, that one can never fully understand each aspect of these continually changing systems. Despite the extensive planning efforts undertaken within this HMP, there will undoubtedly be additional need to address changes to physical, ecological, social, political, and financial factors that influence biodiversity and its conservation.

The work outlined within this habitat management plan is intended to be feasible, yet extensive, given the available workload of refuge staff and community support. As such, additions of biological technicians and other staff may help in achieving these management objectives over the next several years. The management prescriptions outlined here represents a comprehensive effort to guide management primarily over the next 5 years. However, it is impossible to predict the full suite of management strategies and prescriptions required over this period. Some additional strategies may need to be added, others listed here may not be utilized at John Heinz NWR.

5.2 Management Units

In order to implement management prescriptions, the refuge is divided into a series of Habitat Management Units (map C.5). These habitat management units were developed as a result of the major habitat types identified throughout the habitat management planning process.

The refuge was first divided into management units in the early 1980s as part of the refuge Master Plan. These management units were created based on projected management and land use for the refuge. While still referenced to some degree, the alpha-numeric identification system tends not to be referenced in day-to-day management.

In 2005, as part of the *Restoration Management Plan for the Lower Darby Creek*, the Delaware Riverkeeper Network and refuge staff also developed a system of 14 management units for the refuge. These units were delineated based on several factors, such as geographic size, location, landscape influences, and existing in-formal designations currently in use by refuge staff. These management units were then subdivided into sub-units based on the ecological community identified for a particular component of that area. While this system aided in dividing portions of the refuge into distinct units for on-the-ground management, actual management conducted by staff is conducted on a more localized and habitat-based scale (Phillips, personal communication 2009).

No single system of management units is likely to capture all the complexities and requirements for planning and management of the refuge. The habitat management units developed under this plan are intended to coincide with these previous efforts as applicable. Table C.9 is provided as a cross-reference between the HMP management units and those others previously developed for John Heinz NWR.

Map C.5. Habitat Management Units as Defined by the Habitat Management Plan

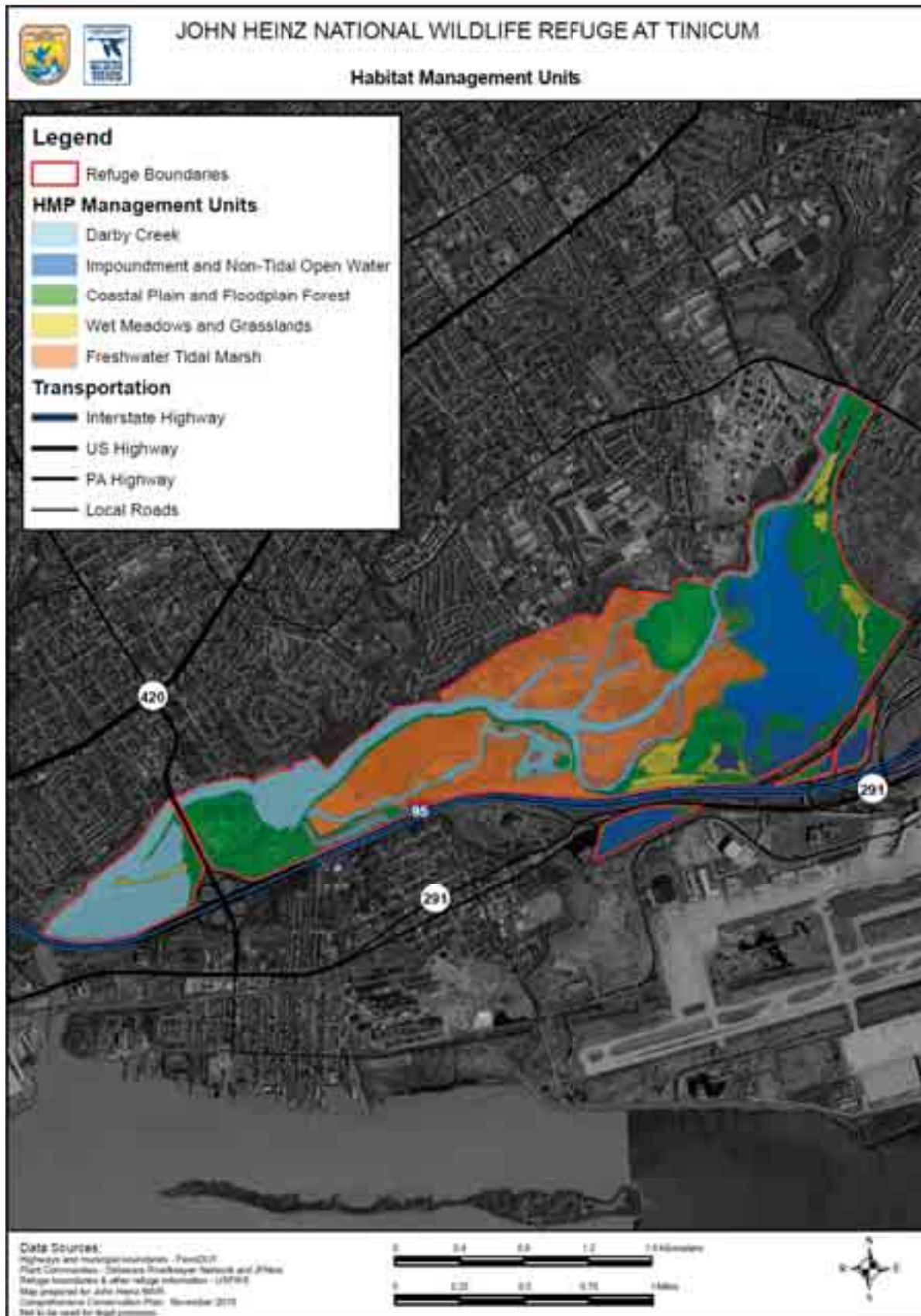


Table C.9. Management Units at John Heinz NWR (see map 5.1 for locations).

Management Unit (Lower Darby Creek Restoration Plan¹)	Resource Planning Unit (Refuge Master Plan²)	Treatment Sub-Units (USFWS³)	HMP Habitat Unit
Cusano Area	FL-1	Lindbergh Berm Woods 5-Acre Field CEEC Back Meadow CEEC Frog Pond Woods Frog Pond Maint/Creek Woods Maint/Lindbergh Woods Parking Area Meadow	Floodplain Forest Grassland Grassland Floodplain Forest Wet Meadow Floodplain Forest Floodplain Forest Grassland
East Impoundment Forest	NL-1	Lower Impoundment Woods Warbler Woods/Middle Impoundment Woods Spill Site Meadow Spill Site Restoration Area Poplar Woods Upper Impoundment Woods Creekside of Dike	Coastal Plain Forest Coastal Plain Forest Wet Meadow Wet Meadow Floodplain Forest Coastal Plain Forest Darby Creek
Impoundment and Dike	MW-1	Impoundment	Impoundment and Nontidal Open Water
	MM-1	Little Horseshoe	Impoundment and Nontidal Open Water
		Big Horseshoe	Impoundment and Nontidal Open Water
	FL-2	Trolley Bed Pond	Impoundment and Nontidal Open Water
South Impoundment Forest		Trolley Bed / Bartram Woods	Floodplain Forest
	MM-2	Oak Island	Coastal Plain Forest
		Oak Island Marsh	Coastal Plain Forest
Henderson Dike and Marsh	FL-4	Henderson Trail	Floodplain Forest
		Penn Dot Property	Freshwater Tidal Marsh
		Mitigation Site 2 (Airport Mitigation Site)	Freshwater Tidal Marsh
		Mitigation Site 1 (Blue Route Mitigation Site) Phrag. Islands	Freshwater Tidal Marsh
	TW-2	Mitigation Site 1 Western Tidal Marsh	Freshwater Tidal Marsh

Management Unit (Lower Darby Creek Restoration Plan ¹)	Resource Planning Unit (Refuge Master Plan ²)	Treatment Sub-Units (USFWS ³)	HMP Habitat Unit
Darby Creek	TC-1	Darby Creek	Darby Creek
	MW-2	Long Hook Creek	Darby Creek
	TL-1	Eastern 420 Lagoon	Darby Creek
	TW-3		
	TL-2	Northern 420 Lagoon	Darby Creek
	TL-3	Southern 420 Lagoon	Darby Creek
	TW-4	Un-named Area	Darby Creek
Hoys Pond Area	FL-3	Hoys Pond	Impoundment and Nontidal Open Water
		Corps Property	Wet Meadow
		Blue Route Spoils Site	Wet Meadow
		I-95 Underpass	Floodplain Forest
		Cross-Dike Field	Wet Meadow
		Hoy's Pond Area Woods	Floodplain Forest
		Corps Property Woods	Floodplain Forest
I-95 Outliers	MW-1	16-Acre Pond	Impoundment and Nontidal Open Water
North Tidal Marsh South Tidal Marsh	FL-2	Bob's Refuge	Floodplain Forest
	TW-1	North Tidal Marsh	Freshwater Tidal Marsh
		South Tidal Marsh	Freshwater Tidal Marsh
SR 420 East	OF-1	420 woods (Westinghouse Property)	Floodplain Forest
SR 420 West	Un-named	420 Split	Floodplain Forest
Folcroft Landfill	SW-1	Folcroft Landfill	Floodplain Forest and Grassland
		Annex	Floodplain Forest

¹Salas, D., D.M. Williams, and R.C. Albert. 2006. Restoration management plan for the Lower Darby Creek. Delaware Riverkeeper Network.

²U.S. Fish and Wildlife Service. 1980. John Heinz National Wildlife Refuge at Tinicum Master Plan.

³Phillips, B. 2009. Personal communication regarding refuge management units. U.S. Fish and Wildlife Service.

5.3 Management Strategies and Prescriptions by Habitat Objective

Objective 1.1 Freshwater Tidal Marsh

Protect the existing 282 acres and restore or acquire an additional 173 acres of freshwater tidal marsh communities throughout the refuge within the next 15 years. Restored marsh would be dominated by native marsh vegetation including, but not limited to, wild rice (*Zizia aquatica*), spatterdock (*Nuphar lutea*), pickerelweed (*Pontederia cordata*), and tick-seed sunflower (*Bidens* spp.). Restored marshes will reestablish greater than 80 percent coverage of native marsh plant species and tidal hydrology that inundates greater than 90 percent of the marsh plain surface with shallow water (less than 1-foot maximum depth) at mean high tide and results in the development of natural channels across the marsh plain surface.

Management Strategies

Continue to:

- Provide technical support to regional corridors and restoration efforts upon request and to targeted projects, such as:
 - ◆ Tinicum Township and Long Hook Creek wildlife and riparian corridor restoration
 - ◆ Philadelphia International Airport marsh mitigation and restoration
- Utilize existing biological datasets to guide species and habitat management restoration.
- Control nonnative, invasive species focused primarily on phragmites and purple loosestrife through a combination of aerial herbicide application, and spot treatments throughout the growing season when populations exceed greater than 5 percent (10 acres) areal coverage across the existing 284.5 acres of freshwater tidal marsh.
- Pursue the completion of additional marsh restoration projects as funding allows.

Within 2 years of plan approval:

- Utilize partnerships with local universities and regional researchers to define a baseline monitoring plan that continues monitoring of variables related to climate change impacts within the existing marsh. Utilize partners to evaluate monitoring data to verify accuracy of previous and current model results.

Within 5 years of plan approval:

- Work with the Service's Delaware Bay Estuary Project office to complete the restoration of a 55-acre wetland area dominated by phragmites to freshwater tidal marsh subject to daily fluctuation in tidal hydrology and dominated by a mix of native species such as pickerelweed, spatterdock, and wild rice. Restored marshes will contain a network of channels across the marsh surface that resemble the pattern, dimension, and profile of channels within reference marsh areas in order to provide aquatic habitat for nursery and juvenile fish.

Within 15 years of plan approval:

- Implement the restoration of a 27.0-acre wetland area dominated by degraded floodplain forest.
- Evaluate restoration of approximately 78 acres of the impoundment to freshwater tidal marsh subject to daily fluctuation in tidal hydrology and dominated by a mix of native species, such as pickerelweed, spatterdock, and wild rice.

Monitoring Components

Continue to:

- Support ongoing research related to sea level rise, marsh accretion rates, and nitrogen removal capacity within tidal marsh by Academy of Natural Sciences.
- Participate in Spill Prevention, Control, and Countermeasure Plans or other environmental emergency action plans as related to the protection of Darby Creek, open water and tidal wetlands on refuge lands.

Within 5 years of plan approval:

- Monitor and adapt marsh restoration projects to climate change impacts to the extent practical.

Within 10 years of plan approval:

- Within 10 years of plan approval, we would begin to reevaluate the refuge's acquisition boundary through the Service's Preliminary Project Proposal process to address rising sea level caused by climate change, as much of what is currently within the refuge boundaries could be under water in the next 50 to 100 years.

Objective 1.2 Coastal Plain and Floodplain Forests

Over the next 15 years, acquire or restore up to 18 acres of coastal plain and floodplain forest, and manage the existing 34 acres of coastal plain forest and 261 acres of floodplain forest communities. These communities will provide healthy foraging and stopover habitat for migratory bird species and provide breeding habitat for the southern leopard frog by: maintaining a canopy dominated by native trees, increasing native understory shrub and sapling cover by 10 percent, and at least a 15 percent reduction in areal coverage of herbaceous, invasive species as compared to levels inventoried in 2005. Also, restore at least 7.7 acres of existing cool-season grass meadows to at least 50 percent cover by native shrub or early successional coastal plain forest species near the 10-acre marsh restoration site and an additional 0.6 acres within the grasslands restored as part of the oil spill wetland mitigation site.

Management Strategies and Prescriptions

Continue to:

- Control exotic, invasive species impacting forested habitats, including Norway maple (*Acer platanoides*), tree-of-heaven (*Ailanthus altissima*), garlic mustard (*Alliaria petiolata*), porcelainberry (*Ampelopsis brevipedunculata*), Oriental bittersweet (*Cephalanthus orbiculatus*), Japanese honeysuckle (*Lonicera japonica*), bush honeysuckle (*Lonicera maackii*), Japanese stiltgrass (*Microstegium vimineum*), and multiflora rose (*Rosa multiflora*) through a combination of herbicide application, biological controls, hand pulling and cutting, and cut-stump treatments where applicable.
- Maintain existing stands of nonnative poplar. Attempt reforestation of native species in canopy gaps as they develop.
- Install occasional tree plantings to close canopy gaps and supplement poor regeneration due to deer browse pressure. Protect saplings with individual tree exclosures to minimize browse and decrease associated tree mortality.
- Finalize the deer management plan originally drafted by USDA Division of Wildlife Services staff in 2009. No deer management control actions would be implemented, but ongoing evaluation of impacts would continue.
- Restrict public access to eagle nesting areas during the breeding season and limit public access to areas utilized by other rare species during their breeding seasons.

Within 5 years of plan approval:

- Reduce and then maintain resident deer populations through the use of wildlife control specialists, based on recommendations of the finalized deer management plan, in order to reduce deer population densities, improve the available deer habitat, improve tree regeneration, and reduce the relative effects on human populations. Monitor regeneration in plant richness and diversity within established monitoring plots.
- Adapt long-term management plan for forest habitats to create mixed-age stands of hardwood species identified as primary components of coastal plain and floodplain target communities.

Within 10 years of plan approval:

- Initiate restoration actions on 15 acres of nonnative poplar-dominated forest to establish a successional trajectory towards coastal plain and floodplain forest communities containing biological diversity and integrity similar to other forest habitats existing on the refuge.

Monitoring Components

Continue to:

- Complete deer browse impact monitoring using established USDA Division of Wildlife Services protocols including the review of deer population densities, deer habitat characterization, tree regeneration analysis, and relative effects on human populations.
- Conduct annual population monitoring (flushing surveys) to evaluate deer population trends on the refuge. Utilize FLiR counts completed in January 2009 and 2010 to evaluate population levels and trends of flushing surveys.

Within 3 years of CCP approval:

- By fall 2011, establish vegetation monitoring plots and record baseline data in order to track long-term richness and diversity of tree, shrub, and herbaceous vegetation and monitor impacts of management activities on biological integrity and diversity.
- By 2013, conduct an ecological inventory and assessment of the floodplain forest parcel identified within the State Highway 420 East Management Unit to assess the ecological cost and benefit of restoring some or all of the area to freshwater tidal marsh.

Within 10 years of CCP approval:

- By 2020, evaluate effectiveness of sustained reductions in deer populations and the recovery ability of plant communities in order to determine where to supplement with native plant reintroductions, if at all.

Objective 1.3 Darby Creek

Over the next 15 years, manage inputs to Darby Creek on the refuge in order to reduce contaminants, reduce stormwater impacts from the refuge, and provide spawning, nursery, foraging, and cover habitat for anadromous and catadromous fish populations and Federal trust fish and wildlife species, including American eel, striped bass, blueback herring, and alewife.

Management Strategies and Prescriptions

Continue to:

- Maintain existing partnerships to assess and manage for water quality improvements impacting the refuge.
- Annually, review and refresh staff in spill response protocols and emergency protection measures.
- Coordinate with USEPA and other stakeholders to close Folcroft and Clearview Landfills and minimize environmental health impacts related to contaminants associated with these sites.
- Assist Delaware Bay Estuary Project Office in coordinating and providing technical assistance to fish passage, stream, and riparian restoration projects within the Darby Creek watershed that have potential to increase available habitat for species utilizing the refuge or improvements to water quality.

Monitoring Components

Continue to:

- Support volunteer-based water quality monitoring along Darby Creek on the refuge as resources allow.

- Support of occasional and ongoing research to evaluate fish tissue surveys, contaminant level accumulation, and other environmental impacts of environmental hazards.
- Complete installation of a water quality monitoring unit along Darby Creek on the refuge to implement long-term and continuous monitoring.

Within 5 years of plan approval:

- Install a network of water quality monitoring equipment along Darby Creek on the refuge to implement long-term and continuous monitoring of salinity, dissolved oxygen, pH, temperature, flow rate, and other parameters.

Objective 2.1 Impoundment and Nontidal Open Water

Restore about half (78 acres) of the 145-acre impoundment to freshwater tidal marsh and manage the remaining 66.6-acre impoundment and 56.4 acres of nontidal open water to enhance habitat available for shorebirds, waterfowl, and wading birds during their peak spring and fall migration periods. Meanwhile, maintain essential habitat for other freshwater species of management concern, such as red-bellied turtles, through a combination of water level management, wetland restoration, and invasive species control.

To the extent practicable, these measures will include the following:

- Annually support migratory shorebirds through a mix of shallow water (less than 6 inches water depth), mudflat with sparse vegetation (less than 10 percent cover), and mudflats with no vegetation, at times of peak migration (spring: May, and fall: mid-August through September).
- Annually support migratory waterfowl through a mix of shallow (6 to 24 inches water depth) flooded vegetation (*Carex spp.*, *Polygonum spp.*, *Peltandra spp.*) at times of peak migration (spring: late March, and fall: late October).
- Annually support migratory wading birds through a mix of shallow remnant pools (6 to 12 inches water depth) at times of peak migration (spring: late March, and fall: late August).
- Sustain State-threatened red-bellied turtles through protection of hibernation, foraging, basking, and nesting habitat.

Management Strategies and Prescriptions

Continue to:

- Control invasive species impacting the impoundment and nearby open water habitats as feasible. Purple loosestrife (*Lythrum salicaria*) and phragmites when they spread over 5 percent (7 acres) of areal coverage across the impoundment and the aggressive native species, spatterdock (*Nuphar lutea*) when it spreads across greater than 10 percent (14 acres) of areal coverage. Control through a combination of herbicide application, mechanical controls, and water level manipulation treatments where feasible.
- Attempt management of impoundment water levels as conditions allow to maximize benefits to migrating shorebirds, waterfowl, waterbirds, and wading birds during each groups' peak migration periods. Adjust drawdown timing and duration to control nonnative, invasive species when herbicide applications become a less cost-effective option against larger populations.
- Enhance and maintain existing dike system to prevent and minimize structural damage sustained to access roads and dikes by flood events and muskrat nesting burrows.
- Close the water control structure into the impoundment during forecasted storm events to minimize stormwater runoff and pollution inputs.

- Work with partners to identify and obtain resources to replace the water control system in the impoundment until evaluation of potential tidal marsh restoration is completed.
- Partner with Tinicum Township to manage stormwater inputs into the impoundment and open waters along Long Hook Creek.

Within 5 years of plan approval:

- Conduct a series of inventory surveys or reviews of species and habitat use of the 145-acre impoundment and freshwater tidal marsh to evaluate benefits to wildlife of open water, managed mudflat, and tidal marsh habitats.
- Complete a study and restoration plan to determine the optimal size, location, and components for restoration of part of the 145-acre impoundment to freshwater tidal marsh and provide improved water control management and habitat enhancement of the remaining impoundment area.
- Evaluate water quality inputs from neighboring stormwater drainage discharging onto refuge lands and initiate development of improvement measures, such as redirecting stormwater inputs from Philadelphia International Airport to Long Hook Creek.

Within 15 years of plan approval:

- Restore approximately half of the 145-acre impoundment to freshwater tidal marsh, actual area and restoration plan will be based on the study recommendations.

Monitoring Components

Continue to:

- Support annual volunteer frog monitoring.
- Monitor water quality (temperature, pH, and dissolved oxygen) and water level fluctuations within the impoundment throughout the year.
- Conduct weekly inventories and monitoring of shorebirds, waterfowl, waterbirds, and wading birds use and abundance within the impoundment during spring and fall migrations. Use data to document the ongoing effectiveness of water level management activities and adjust management protocols as necessary.
- Conduct migratory bird surveys for landbirds, waterbirds, and waterfowl.
- Complete fisheries inventory of isolated ponds on refuge lands.

Within 10 years of plan approval:

- Assess potential changes in flood elevations of existing dikes and facilities on and adjacent to the refuge and evaluate adaptation to changes in flood elevations.
- Conduct baseline red-bellied turtle inventory surveys and create a long-term monitoring program within the impoundment, open water areas, and the freshwater tidal marsh to determine forage, hibernaculum, and nesting sites. Where feasible, complete inventories in partnership with local universities and State agencies.

Objective 2.2 Wet Meadows, Grasslands, and Early Successional Habitats

Manage up to 64 acres to create a mix of native grasses and flowering plants, within components including early successional shrubs and trees to sustain stopover foraging and cover for migratory landbirds. Specifically,

1. Annually, manage habitat around Frog Pond and Hoy's Pond fringe as native-species dominated wet meadow to contain less than 15 percent areal coverage of tree and shrub species, and no greater than 5 percent bare ground, and so that at least 90 percent of the total areal cover is comprised of native species.
2. Within 10 years of plan approval, restore biological diversity to the existing 7.1 acres of grasslands surrounding the visitor center and refuge entrance, so that at least 90 percent of the total areal cover is comprised of native species and support a minimum of 7 species of native grasses, and 7 species of native flowering plants.

Management Strategies and Prescriptions

Continue to:

- Annually mow to maintain the existing 72 acres of wet meadow, grassland, and forest opening habitats for wildlife, environmental education, and interpretive purposes.
- Control exotic, invasive species impacting wet meadow and grassland habitats, including Oriental bittersweet, Japanese hops, Japanese honeysuckle, purple loosestrife, phragmites, mile-a-minute vine, and multiflora rose through a combination of herbicide application, hand pulling, and mowing.
- Maintain and create vernal pools and wet meadows for amphibian breeding and grassland bird stopover habitat.
- Promote warm-season grass establishment in areas previously dominated by cool-season grasses.

Within 5 years of plan approval:

- Cease annual mowing of 8 acres of existing grasslands targeted for successional transition into a scrub-shrub dominated habitat type.
- Install supplemental plantings within the grasslands surrounding the visitor center to enhance species diversity to levels targeted.

Within 15 years of plan approval:

- Complete habitat management, compatible use, and public use planning of Folcroft Landfill site within 2 years of site remediation and release.

Monitoring Components

Continue to:

- Annually conduct anuran call surveys of known vernal pools to monitor species and their use of areas for breeding sites. Utilize data to document sensitive breeding areas and long-term effectiveness of management activities in order to adjust management protocols as necessary.

Literature Cited

- Albert, R.C. 1988. The historical context of water quality management for the Delaware Estuary. *Estuaries* 11(2). Estuarine Research Federation.
- Allombert, S., A.J. Gaston, J. Martin. 2005. A natural experiment on the impact of overabundant deer on songbird populations. *Biological Conservation* 126:1–13.
- American Ornithologists' Union (AOU). 1983. Check-list of North American birds, 6th edition. Allen Press, Inc., Lawrence, KS. 877 pp.
- Andrew, J.M. and J.A. Mosher. 1982. Bald eagle nest site selection and nesting habitat in Maryland. *Journal of Wildlife Management* 46:382-390.
- Aniskowicz, B.T. 1981. Behavior of a male least bittern *Ixobrychus exilis* after loss of mate. *Wilson Bulletin* 93:395-397.
- Barnes, J.H. and W.D. Sevon. 2002. The geological story of Pennsylvania (3rd edition): Pennsylvania Geological Survey, Educational Series 4, 44 pp.
- Baumann, P.C. 2002. Beneficial use impairment #4: fish tumors and other deformities. In: Workshop on Delisting Criteria on the Detroit River Area of Concern. Proceedings of a workshop held at the University of Windsor, April 26-27, 2002. Environment Canada, Burlington, Ontario. 124 pp.
- Bell, B.A. 2005. The effects of crude oil on the reproduction of freshwater turtles. Doctor of Philosophy Thesis. Submitted June 2005. Drexel University. 129 pp.
- Bent, A.C. 1938. Life histories of North American birds of prey. Part 2. U.S. Natural Museum Bulletin 170. 482 pp., 92 pls.
- Bertin, R.I. 1977. Breeding habitats of the wood thrush and veery. *The Condor* 79:303-11.
- Botton, M.L., R.E. Loveland, and T.R. Jacobsen. 1994. Site selection by migratory shorebirds in Delaware Bay, and its relationship to beach characteristics and abundance of horseshoe crab (*Limulus polyphemus*) eggs. *Auk* 111:605-616.
- Bozeman, E.L., Jr. and M.J. Van Den Avyle. 1989. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (South Atlantic)--alewife and blueback herring. U.S. Fish and Wildlife Service, Biological Report 82(11.111). 17 pp.
- Bushman, E.S. and G.D. Therres. 1988. Habitat management guidelines for forest interior breeding birds of coastal Maryland. Maryland Department of Natural Resources, Wildlife Technical Publication 88-1. 50 pp.
- Campbell, R.W., N.K. Dawe, I. McTaggart-Cowan, J.M. Cooper, G.W. Kaiser, and M.C. McNall. 1990. The birds of British Columbia. Volume 2. Nonpasserines: diurnal birds of prey through woodpeckers. University of British Columbia Press, Vancouver, BC. 636 pp.
- Castro, G. and J.P. Myers. 1993. Shorebird predation on eggs of horseshoe crabs during spring stopover on Delaware Bay. *Auk* 110:927-930.
- Christman, S.P. 1984. Breeding bird response to greentree reservoir management. *Journal of Wildlife Management* 48:1164-1172.
- City of Philadelphia. 2008. Philadelphia's Air Quality Report. Department of Public Health Air Management Services. 44 pp. [Online version available at <<http://www.phila.gov/health/airmanagement/>>]

- Clark, K.E., L.J. Niles, and the North Atlantic Shorebird Habitat Working Group. 2000. U.S. Shorebird Conservation Plan: North Atlantic Regional Shorebird Plan Version 1.0. <http://www.fws.gov/shorebirdplan/RegionalShorebird/downloads/NATLAN4.pdf>; accessed January 2012.
- Clark, R.J. 1975. A field study of the short-eared owl (*Asio flammeus*) Pontoppidan in North America. Wildlife Monographs 47:1-67.
- Cohen, M. and J. Johnson. 2004. Pennsylvania Important Bird Area #73: John Heinz National Wildlife Refuge at Tinicum Phase 1 Report. Audubon Society.
- Craft, C. 2007. Freshwater input structures soil properties, vertical accretion, and nutrient accumulation of Georgia and U.S. tidal marshes. Limnology and Oceanography 52(3):1220-1230.
- D'Angelo, G.J. 2009. Personal Communication.
- D'Angelo, G.J. 2012. Final white-tailed deer management plan for John Heinz National Wildlife Refuge at Tinicum, Philadelphia, Pennsylvania. August 2012. USDA-APHIS. 76 pp.
- Darby Creek Valley Association (DCVA). 2005. Darby Creek watershed comprehensive plan. [Online version available at <[http:// www.dcva.org](http://www.dcva.org)>]
- deCalesta, D.S. 1994. Impact of white-tailed deer on songbirds within managed forests in Pennsylvania. Journal of Wildlife Management 58: 711-718.
- DeGraaf, R.M., G.M. Whitman, J.W. Lanier, B.J. Hill, and J.M. Keriston. 1980. Forest habitat for birds of the Northeast. U.S. Forest Service, Northeast Forest Experiment Station. 598 pp.
- DeGraaf, R.M. and D.D. Rudis. 1983. Amphibians and reptiles of New England. Habitats and natural history. University of Massachusetts Press. vii + 83 pp.
- Delaware Estuary Program (DEP). 1996. Comprehensive conservation and management plan for the Delaware Estuary. Wilmington, DE. 470 pp.
- Delaware River Basin Commission (DRBC). 2004. 2004 Delaware River and Bay Surface Water Quality Assessment Report for 2000 – 2002.
- del Hoyo, J., A. Elliot, and J. Sargatal. 1996. Handbook of the birds of the world. Volume 3. Lynx Editions. Barcelona. 821 pp.
- Elliot, L. 1978. Social biology and foraging ecology of the eastern chipmunk (*Tamias striatus*) in the Adirondack Mountains. Smithsonian Contributions to Zoology 265:1-107.
- Entrix, Inc. 2005. Final Report: Sunoco Pipeline Release Incident at John Heinz National Wildlife Refuge, Philadelphia, PA. Prepared for Sunoco, Inc. (R&M) and Sun Pipeline Company, Philadelphia, PA. June 3, 2005. Project No.: 7089309.
- Ernst, C.H. and R.W. Barbour. 1972. Turtles of the United States. University Press of Kentucky, Lexington.
- Fay, C.W., R.J. Neves, and G.B. Pardue. 1983. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (Mid-Atlantic): alewife/blueback herring. FWS/OBS-82/11.9.
- Feunteun, E., P. Laffaille, T. Robinet, C. Briand, A. Baisez, J.M. Olivier, and A. Acou. 2003. A review of upstream migration and movements in inland waters by anguillid eels: toward a general theory. In: Eel Biology (K. Aida, K. Tsukamoto, and K. Yamauchi, eds.), pp. 191-213. Springer, Tokyo.

- Flowerdew, J.R. and S.A. Elwood. 2001. Impact of woodland deer on small mammal ecology. *Forestry* 74: 277-287.
- Frazer, C., J.R. Longcore, and D.G. McAuley. 1990a. Habitat use by postfledging American black ducks in Maine and New Brunswick. *Journal of Wildlife Management* 54:451-459.
- . 1990b. Home range and movements of postfledging American black ducks in eastern Maine. *Canadian Journal of Zoology* 68:1288-1291.
- Goodrich, L., M. Brittingham, J. Bishop, P. Barber. 2001. Wildlife habitat in Pennsylvania: past, present, and future. Pennsylvania Department of Conservation and Natural Resources. Harrisburg, PA. [Online version available at <<http://www.dcnr.state.pa.us/wlhabitat/commonwealth.aspx>>]
- Green A.W., W.L. Kendall, H.P. Laskowski, J.E. Lyons , L. Socheata, and M.C. Runge. 2008. Draft version of the USFWS R3/R5 regional impoundment study. U. S. Fish and Wildlife Service.
- Green, N. 1985. The bald eagle. In: Audubon Wildlife Report 1985 (R.L. DiSilvestro, ed.), pp. 508-531. National Audubon Society, New York.
- Haro, A.J. and W.H. Krueger. 1991. Pigmentation, otolith rings, and upstream migration of juvenile American eels (*Anguilla rostrata*) in a coastal Rhode Island stream. *Canadian Journal of Zoology* 69:812-814.
- Harrison, C. 1978. A field guide to the nests, eggs and nestlings of North American birds. Collins, Cleveland, OH.
- Hassler, T.J. 1988. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (Pacific Southwest)--striped bass. U.S. Fish and Wildlife Service Biological Report 83(11.82). U.S. Army Corps of Engineers, TR EL-82-4. 29 pp.
- Hayhoe, K., C.P. Wake, T.G. Huntington, L. Luo, M.D. Schwartz, J. Sheffield, E. Wood, B. Anderson, J. Bradbury, A. DeGaetano, T.J. Troy, and D. Wolfe. 2007. Past and future changes in climate and hydrological indicators in the U.S. Northeast. *Climate Dynamics* 28(4):381-407.
- Herpetological Associates. 2001a. Endangered and threatened wildlife species surveys in wetlands throughout Philadelphia International Airport, Delaware and Philadelphia Counties, Pennsylvania.
- . 2001b. Master plan technical report No. 2: a survey of fishes of the Philadelphia International Airport and the adjacent Delaware River Estuary.
- Intergovernmental Panel on Climate Change (IPCC). 2007. Summary for policymakers of the synthesis report of the IPCC Fourth assessment report. Valencia, Spain. [Online version available at <http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf>]
- Iverson, L., A. Prasad, and S. Matthews. 2008. Potential changes in suitable habitat for 134 tree species in the northeastern United States. *Mitigation and Adaptation Strategies for Global Change* 13(5-6):487-516.
- Kreeger, D., J. Adkins, P. Cole, R. Najjar, D. Velinsky, P. Conolly, and J. Kraeuter. 2010. Climate change and the Delaware Estuary: three case studies in vulnerability assessment and adaptation planning. June 2010. Partnership for the Delaware Estuary, PDE Report No. 10-01. 117 pp.
- Kuchler, A.W. 1964. Potential natural vegetation of the conterminous United States. American Geographical Society. Special Publication No. 36.
- Kushlan, J.A. 1973. Least bittern nesting colonially. *Auk* 90:685-686.

- Kushlan, J.A., M.J. Steinkamp, K.C. Parsons, J. Capp, M.A. Cruz, M. Coulter, I. Davidson, L. Dickson, N. Edelson, R. Elliot, R.M. Erwin, S. Hatch, S. Kress, R. Milko, S. Miller, K. Mills, R. Paul, R. Phillips, J.E. Saliva, B. Sydeman, J. Trapp, J. Wheeler, and K. Wohl. 2002. Waterbird Conservation for the Americas: The North American Waterbird Conservation Plan, Version 1. Waterbird Conservation for the Americas. Washington, DC. Online version available at: http://www.waterbirdconservation.org/pdfs/plan_files/complete.pdf; accessed January 2012.
- Latham, R.E., J. Beyea, M. Benner, C.A. Dunn, M.A. Fajvan, R.R. Freed, M. Grund, S.B. Horsley, A.F. Rhoads and B.P. Shissler. 2005. Managing white-tailed deer in forest habitat from an ecosystem perspective: Pennsylvania case study. Report by the Deer Management Forum for Audubon Pennsylvania and Pennsylvania Habitat Alliance, Harrisburg, PA. xix + 340 pp.
- Leimgruber, P., W.J. McShea, and J. Rappole. 1994. Predation on artificial nests in large forest blocks. *Journal of Wildlife Management* 58: 254-260.
- Lippson, M.A.J., M.S. Haire, A.F. Holland, F. Jacobs, J. Jensen, R.L. Moran-Johnson, T.T. Polgar, and W.A. Richkus. 1979. Environmental atlas of the Potomac Estuary. Williams and Heintz Map Corp., Washington, DC.
- Low, D.J., D.J. Hippe, and D. Yannacci. 2002. Geohydrology of Southeastern Pennsylvania. U.S. Department of the Interior, U.S. Geological Survey, New Cumberland, PA. Water-Resources Investigations Report 00-4166. 361 pp.
- Lyons, J.E., M.C. Runge, W.L. Kendall, H. Laskowski, S. Lor. 2005. Timing of Impoundment drawdowns and impact on waterbird, invertebrate, and vegetation communities within managed wetlands. U.S. Geological Survey, Refuge Cooperative Research Program, Laurel, MD.
- McCormick, J., R. Grant, and R. Patrick. 1970. Two studies of Tinicum Marsh. The Conservation Foundation. 124 pp.
- McCullough, D.R. 2001. Male harvest in relation to female removals in a black-tailed deer population. *Journal of Wildlife Management* 65: 46-58.
- McMenamin, M. 2008. Facility manager, John Heinz National Wildlife Refuge at Tinicum. Personal Communication.
- Meanley, B. 1969. Natural history of the king rail. *North American Fauna* 67:1-108.
- Merendino, M.T. and C.D. Ankney. 1994. Habitat use by mallards and American black ducks breeding in central Ontario. *Condor* 96:411-421.
- Meretsky, V., R. Fischman, J. Karr, D. Ashe, J. Scott, R. Noss, and R. Schroeder. 2006. New directions in conservation for the National Wildlife Refuge System. *BioScience* 56(2):135–143.
- Mitch, W.G. and J.G. Gosselink. 1993. *Wetlands*. Second Edition. J. Wiley and Sons Press. pp. 267-291.
- Najjar, R.G. 2010. Potential impact of climate change on salinity of the Delaware Estuary. A Report for the Partnership of the Delaware Estuary. 2010. In: *Climate Change and the Delaware Estuary: Three Case Studies in Vulnerability Assessment and Adaptation Planning*. Partnership for the Delaware Estuary, PDE Report No. 10-01(Kreeger, D., J. Adkins, P. Cole, R. Najjar, D. Velinsky, P. Conolly, and J. Kraeuter), appendix A. June 2010. 117 pp.
- Najjar, R.G., H.A. Walker, P.J. Anderson, E.J. Barron, R.J. Bord, J.R. Gibson, V.S. Kennedy, C.G. Knight, J.P. Megonigal, R.E. O'Connor, C.D. Polsky, N.P. Psuty, B.A. Richards, L.G. Sorenson, E.M. Steele, and R.S. Swanson. 2000. The potential impacts of climate change on the Mid-Atlantic Coastal Region. *Climate Research* 14:219–233.

- National Oceanic and Atmospheric Administration (NOAA). 2000. Lower Darby Creek Area 33 Report for EPA Facility ID: PASFN0305521.
- . 2008. National Oceanic and Atmospheric Administration, Satellite and Information Service. 2008. United States Historical Climatology Network (USHCN). Data from National Climate Data Center. [Online version available at <<http://wf.ncdc.noaa.gov/oa/climate/research/ushcn/ushcn.html>>]
- Natural Resource Conservation Service (NRCS). 2009. National Cooperative Survey Data for Delaware County, Pennsylvania. Web Soil Survey, Version 1.0. Accessed February 2009. [Online version available at <<http://websoilsurvey.nrcs.usda.gov/app/>>]
- Nixon, C.M. and L.P. Hansen. 1987. Managing forests to maintain populations of gray and fox squirrels. Illinois Department of Conservation Technical Bulletin No. 5. Springfield, IL. 35 pp.
- Odum, W.E., T.J. Smith III, J.K. Hoover, and C.C. McIvor. 1984. The ecology of freshwater tidal marshes of the United States East Coast: a community profile. U. S. Fish and Wildlife Service. FWS/OBS-87/17. Washington, DC. 177 pp.
- Park, R.A., M.S. Trehan, P.W. Mausel, and R.C. Howe. 1989. The effects of sea level rise on U.S. Coastal Wetlands. In: The Potential Effects of Global Climate Change on the United States, Appendix B - Sea Level Rise (J. B. Smith and D. A. Tirpak, eds.), pp. 1-1 to 1-55. U.S. Environmental Protection Agency, Washington, DC.
- Palmer, R.S. (editor). 1962. Handbook of North American birds. Vol. 1. Loons through flamingos. Yale University Press, New Haven, CT. 567 pp.
- Partners in Flight (PIF). 1999. Bird Conservation Plan For the Mid-Atlantic Coastal Plain (Physiographic Area 44), April 1999. Version 1.0. American Bird Conservancy. Williamsburg, VA.
- Pederson, B.S. and A.M. Wallis. 2004. Effects of white-tailed deer herbivory on forest gap dynamics in a wildlife preserve, Pennsylvania, U.S.A. *Natural Areas Journal*. 24: 82-94.
- Pennsylvania Game Commission (PGC) and Pennsylvania Fish and Boat Commission (PFBC). 2005. Pennsylvania's wildlife habitat action plan, Version 1.0a. Harrisburg, PA. [Online version available at <<http://www.pgc.state.pa.us/pgc/cwp/view.asp?a=496&q=162067>>]
- Pennsylvania Natural Heritage Program (PNHP). 2008. A natural heritage inventory of Philadelphia County. Western Pennsylvania Conservancy, Middletown, PA.
- Petit, L.J. and D.R. Petit. 1996. Factors governing habitat selection by prothonotary warblers: field tests of the Fretwell-Lucas models. *Ecological Monographs* 66:367-387.
- Philadelphia Water Department (PWD). 2002 and July 2004 update. Darby-Cobbs Watershed comprehensive characterization report.
- Phillips, B. 2008. Refuge biologist, John Heinz National Wildlife Refuge at Tinicum. Personal Communication.
- Pinkney, A.E., J.C. Harshbarger, M.R. Roberts. 2004. Tumor prevalence in brown bullheads (*Ameiurus nebulosus*) from Darby Creek, John Heinz National Wildlife Refuge at Tinicum, Philadelphia, PA. CBFO-C04-03 and PAFO-C04-02. 37 pp.
- Reed, J.M. and L.W. Oring. 1993. Philopatry, site fidelity, dispersal, and survival of spotted sandpipers. *Auk* 110:541-551.
- Roboski, J.C. and M.K. Causey. 1981. Incidence, habitat use, and chronology of woodcock nesting in Alabama. *Journal of Wildlife Management* 45:793-797.

- Rooney, T.P. 2001. Deer impacts on forest ecosystems: a North American perspective. *Forestry* 74: 201-208.
- Roth, R.R. 1987. Assessment of habitat quality for wood thrush in a residential area. In: Integrating man and nature in the metropolitan environment: Proceedings of the National Symposium on Urban Wildlife, Chevy Chase, Maryland, 4-7 November, 1986 (L.W. Adams and D.L. Leedy, eds), pp. 139-149. National Institute for Urban Wildlife, Columbia, MD.
- Roth, R.R., M.S. Johnson, and T.J. Underwood. 1996. Wood thrush (*Hylocichla mustelina*). In: The Birds of North America, No. 246 (A. Poole and F. Gill, eds.). Academy of Natural Sciences, Philadelphia, and American Ornithologists' Union, Washington, DC. 28 pp.
- Ryan, T.J. and C.T. Winne. 2001. Effects of hydroperiod on metamorphosis in *Rana sphenoccephala*. *American Midland Naturalist* 145:46-53.
- Salas, D., D.M. Williams, and R.C. Albert. 2006. Restoration management plan for the Lower Darby Creek. Delaware Riverkeeper Network. 101 pp.
- Schieck, P. and H.E. Cox. 1970. Trolleys of Lower Delaware Valley Pennsylvania. Harold and Cox. 86 pp.
- Scull, N. and G. Heap. 1752. A map of Philadelphia and parts adjacent: with a perspective view of the Statehouse. Library of Congress Geography and Map Division, Washington, DC. [Online version available at <<http://hdl.loc.gov/loc.gmd/g3824p.ct000294>>]
- Spendelov, J.A. and S.R. Patton. 1988. National atlas of coastal waterbird colonies in the contiguous United States: 1976-1982. U.S. Fish and Wildlife Service, Biological Report 88(5). 326 pp.
- Sportfishing and Boating Partnership Council. 2006. National fish habitat action plan. 28 pp.
- Stasz, J.L. 1996. Worm-eating warbler (*Helminthos vermivorus*). In: Atlas of the breeding birds of Maryland and the District of Columbia (C.S. Robbins and E.A.T. Blom, eds.), pp. 352-353. University of Pittsburgh Press, Pittsburgh, PA.
- Stewart, R.E. and C.S. Robbins. 1958. Birds of Maryland and the District of Columbia. North American Fauna No. 62. U.S. Government Printing Office, Washington, DC.
- Stevens, S. 1964. Pennsylvania, birthplace of a nation. Random House. New York. pp. 5-26.
- Stiles, F.G. and A.F. Skutch. 1989. A guide to the birds of Costa Rica. Cornell University Press, Ithaca, NY. 511 pp.
- Stolz, G. 2009. Refuge manager, John Heinz National Wildlife Refuge at Tinicum. Personal Communication
- Sweka, J. and J. Mohler. 2010. Fish species richness on the John Heinz National Wildlife Refuge at Tinicum. U.S. Fish and Wildlife Service, Northeast Fishery Center.
- Swift, B.L. 1987. An analysis of avian breeding habitats in Hudson River tidal marshes. New York State Department of Environmental Conservation, Division of Fish and Wildlife, Delmar, NY. Unpublished report. 62 pp.
- Terres, J.K. 1980. The Audubon Society encyclopedia of North American birds. Alfred A. Knopf, New York.
- Thomson, K.S., W.H. Weed III, A.G. Taruski, and D.E. Simanek. 1978. Saltwater fishes of Connecticut. 2nd edition. State Geological and Natural History Survey of Connecticut, Department of Environmental Conservation, Bulletin 105. viii + 186 pp.

- Union of Concerned Scientists (UCS). 2008. Climate Change in Pennsylvania: Impacts and Solutions for the Keystone State. UCS Publications, Cambridge, MA. [Online version available at <<http://www.climatechoices.org/pa>>]
- Urban, Christopher. 2012. Chief, Natural Diversity Section, Pennsylvania Fish and Boat Commission. Personal communication.
- U.S. Environmental Protection Agency (USEPA). 2006. USEPA Region 3. Lower Darby Creek current site information. [Online version available at <<http://www.epa.gov/reg3hwmd/npl/PASFN0305521.htm/>>]
- U.S. Fish and Wildlife Service (USFWS). 1999. Fulfilling the promise: the National Wildlife Refuge System. U.S. Fish and Wildlife Service, Arlington, VA.
- . 2003. Biological integrity, diversity, and environmental health. USFWS Policy 601 FW3. U.S. Fish and Wildlife Service, Arlington, VA.
- . 2004. A blueprint for the future of migratory birds, migratory bird program strategic plan 2004-2014. U.S. Fish and Wildlife Service, Migratory Birds and State Programs, Arlington, VA. 27pp.
- . 2008a. New England Mid-Atlantic Coast Bird Conservation Region (BCR 30) Implementation Plan. U.S. Department of the Interior, U.S. Fish and Wildlife Service, Region 5, Atlantic Coast Joint Venture, Hadley, MA. [Online version available at <http://www.acjv.org/BCR_30/BCR30_June_23_2008_final.pdf>]
- . 2008b. Birds of Conservation Concern 2008. U.S. Department of Interior, U.S. Fish and Wildlife Service, December 2008. Division of Migratory Bird Management. Arlington, VA. 85 pp. [Online version available at <<http://www.fws.gov/migratorybirds/>>]
- . 2009a. North Atlantic Landscape Conservation Cooperative development and operations plan. December 2009. U.S. Department of Interior, U.S. Fish and Wildlife Service, Northeast Region. Hadley, MA. 38 pp.
- . 2009b. John Heinz National Wildlife Refuge Web site. Accessed April 2009 [Online version available at <<http://www.fws.gov/northeast/heinz/>>].
- U.S. Geological Survey (USGS). 2009. Pennsylvania StreamStats data obtained for Darby Creek within the John Heinz National Wildlife Refuge at Tinicum location. Accessed on April 2009. [Online version available at <<http://water.usgs.gov/osw/streamstats/pennsylvania.html>>]
- Warren Pinnacle Consulting, Inc. 2010. Application of the Sea Level Affecting Marshes Model (SLAMM 6) to John Heinz National Wildlife Refuge. Prepared for U.S. Fish and Wildlife Service, National Wildlife Refuge System, Arlington VA. December 2010.
- Weller, M.W. 1961. Breeding biology of the least bittern. *Wilson Bulletin* 73:11-35.
- Weston, N.B., R.E. Dixon, and S.B. Joye. 2006. Ramifications of increased salinity in tidal freshwater sediments: geochemistry and microbial pathways of organic matter mineralization. *Journal of Geophysical Research* 111, G01009.
- Wilcove, D.S., D. Rothstein, J. Dubow, A. Phillips, and E. Losos. 1998. Quantifying threats to imperiled species in the United States. *BioScience* 48:607–617.
- Woodward, L. 2009. Former Deputy refuge manager at John Heinz National Wildlife Refuge. Personal Communication.

Appendix A. Plan Development Team

Lead Author

Dan Salas
Ecologist, ESA Certified
JFNew

Contributing Authors and Cooperators

Gary M. Stolz
Refuge Manager
John Heinz NWR

Brendalee Phillips
Refuge Biologist
John Heinz NWR

Larry A. Woodward
Deputy Refuge Manager
John Heinz NWR

Mike McMennamin
Maintenance Specialist
John Heinz NWR

Rob Allen
Contaminants Biologist
John Heinz NWR

Beth Goldstein
Refuge Planner
Northeast Region 5

Nicole Staskowski
Regional Manager
JFNew

Gino D'Angelo
Wildlife Biologist
USDA APHIS Wildlife Services

Jan Taylor
Regional Biologist
Northeast Region 5

Hal Laskowski (retired)
Regional Biologist
Northeast Region 5

Appendix B. Potential Habitat Management Strategies

This section identifies potential management tools or strategies that are available to land managers to achieve desired habitat objectives. These strategies were identified through successful refuge application, literature review and in consultation with other land managers.

Invasive Species Management

Controlling and managing invasive species is a strategy for maintaining the biological integrity and diversity of all habitats. The Fulfilling the Promise National Invasive Species Management Strategy Team developed a national strategy for management of invasive species for the Refuge System in 2002. The strategy recommends the following priority order of action for invasive species management:

1. Prevent invasion of potential invaders.
2. Eradicate new or small infestations.
3. Control and contain large established infestations.

Potential management strategies for preventing invasive species, prioritizing control efforts for established invasive species, and controlling invasive species are described in detail below. Prior to the initiation of invasive species control efforts, the refuge manager must understand the biology of the species to be controlled. A number of resources are available on the internet to assist refuge managers with invasive species management. This is a partial list of helpful Web sites.

- Service Managing Invasive Plants Modules: <http://www.fws.gov/invasives/staffTrainingModule/index.html> (accessed January 2012).
- National Invasive Species Information Center: <http://invasivespeciesinfo.gov/index.shtml> (accessed January 2012).
- National Biological Information Infrastructure Invasive Species Information Node: <http://invasivespecies.nbii.gov/> (accessed January 2012).
- The Global Invasive Species Initiative: <http://tncinvasives.ucdavis.edu/> (accessed January 2012)
- USGS Invasive Species Program: <http://biology.usgs.gov/invasive/> (accessed January 2012)
- Mid-Atlantic Exotic Pest Plant Council (MA-EPPC): <http://www.ma-eppc.org/> (accessed January 2012).
- Weeds Gone Wild: <http://www.nps.gov/plants/alien/index.htm> (accessed January 2012).

Refuge managers should conduct appropriate and applicable pest detection, environmental surveillance, and monitoring before, during, and after any management activity to determine whether pest management goals are achieved and whether the activity caused any significant unanticipated effects. The lowest risk, most targeted approach for managing invasive species should always be utilized (Department of Interior 2007).

Work with Partners

Working with partners is the most effective way to manage invasive species on a refuge. Control efforts on the refuge will have little long-term impact if the surrounding lands and waters are infested with invasive species.

Incorporate Invasive Species Prevention in All Facilities and Construction Projects

Minimize ground disturbance and restore disturbed areas. Require mulch, sand, gravel, dirt, and other construction materials to be certified as free of noxious weed seeds. Avoid stockpiles of weed-infested materials.

To prevent the spread of invasives along transportation corridors, maintain invasive species-free zones along trails, around parking lots and boat launches, and at other related facilities. Inspect these areas often and control new infestations immediately. Minimize the number and size of roads on the refuge.

Remove all mud, dirt, and plant parts from all equipment between projects or when equipment is moved from one location to another.

Incorporate Invasive Species Prevention in Impoundment Design and Management

Minimize infrastructure development in managed wetland units to reduce unnecessary dikes, waterways, and access roads. These often are sources of infestation and pathways to spread invasive species.

Plant a native cool-season grass mix that will establish quickly to stabilize banks and dikes and to prevent the establishment of invasive species. Consider one of the following mixes recommended by the Natural Resources Conservation Service for New York State:

1. Canada wild rye (*Elymus canadensis*) (5 lb. per acre), riverbank wild rye (*E. riparius*) (3 lb. per acre), and Eastern bottlebrush grass (*E. hystrix*) (2 lb. per acre).
2. Canada wild rye (4 lb. per acre), riverbank wild rye (4 lb. per acre), Virginia wild rye (*E. virginicus*) (4 lb. per acre), and rough bentgrass (*Agrostis scabra*) (1 lb. per acre).

For either mix, consider adding a cover crop of seed oats (*Avena sativa*) or triticale (*Triticale hexaploide*) so bare soil is not exposed to erosion or to invasive plant seeds and rhizomes. This nonnative plant will establish quickly and then drop out of the mix after 1 to 2 years.

Time water manipulation activities, such as flooding and drawdowns, to minimize the germination and spread of invasive plant seeds and to encourage the growth of native species. Flooding can also be used to stunt the growth of some invasive species as described below under water level management.

Early Detection and Rapid Response

Where prevention is not possible, early detection and rapid response is the next best strategy. Success will depend, in part, on participation by all refuge staff, contractors, volunteers, and visitors in efforts to report and respond to invasions. The refuge manager must have access to up-to-date reliable scientific and management information on species that are likely to invade. The following sources for State and regional invasive species information and updates provide an initial list of potential invasive species present within the region:

- PA Invasive Species Council: <http://www.invasivespeciescouncil.com/default.aspx> (accessed January 2012).
- Mid-Atlantic Exotic Pest Plant Council (MA-EPPC): www.ma-eppc.org (accessed January 2012).
- WeedUS Natural Area Weed Database of the US: <http://www.invasive.org/weedus/index.html> (accessed January 2012).

These lists, along with identification information for each species, should be distributed amongst refuge staff and volunteers and posted in refuge facilities. In addition to these lists, a list of experts should be maintained by the refuge manager to facilitate rapid and accurate species identification for species that are particularly difficult to identify. The refuge manager should communicate with the Pennsylvania Invasive Species Council and Mid-Atlantic Exotic Pest Plant Council regarding the status of early detection species in the region.

When small infestations are spotted, they should be eradicated as soon as possible. The site must then be monitored for several years to ensure the control was effective.

Prioritizing Invasive Species Control Efforts

The first step in prioritizing invasive species control efforts is to determine the abundance and distribution of invasive species on the refuge or management unit. However, control efforts should not be delayed to collect statistically rigorous survey data. Baseline data regarding the location of many invasives on the refuge already may be available via observations of staff, volunteers, contractors, and refuge visitors. These observations should be documented and mapped. If a more formalized mapping procedure is desired the North American Weed Management Association (<http://www.nawma.org>; accessed January 2012) has information on mapping procedures.

There are a number of ranking tools to assist land managers with the daunting task of prioritizing their invasive plant control efforts. The Fulfilling the Promise National Invasive Species Management Strategy Team recommends using the following order of priority to determine appropriate actions:

1. Smallest scale of infestation.
2. Poses greatest threat to land management objectives.
3. Greatest ease of control.

Table C.3 provides a prioritization summary of known invasive exotic species occurring at John Heinz NWR. The prioritization of species within that table follows the prioritization rankings listed above. Keep in mind that the prioritization in table C.3 is considered for invasive species across the entire refuge. Some species listed as “medium” priority across the refuge, may be a “high” priority for a particular habitat (such as *Phragmites* for the freshwater tidal marsh). This prioritization should be periodically reviewed and updated as necessary to reflect changes in species, distribution, and effectiveness of management.

When limited resources prevent the treatment of entire populations, the following order of priority is recommended:

1. Treat the smallest infestations (satellite populations).
2. Treat infestations on pathways of spread.
3. Treat the perimeter and advancing front of large infestations.

The following ranking systems are available for prioritizing invasive plant species control:

- Morse, L.E., J.M. Randall, N. Benton, R. Hiebert, and S. Lu. 2004. An Invasive Species Assessment Protocol: Evaluating Nonnative Plants for Their Impact on Biodiversity. Version 1. NatureServe, Arlington, Virginia. Web site: <http://www.natureserve.org/getData/plantData.jsp> (accessed January 2012).
- R. D. Hiebert and J. Stubbendieck, Handbook for Ranking Exotic Plants for Management and Control (Natural Resources Report NPS/NRMWRO/NRR-93/08), U.S. National Park Service, Midwest Regional Office, Omaha, Nebraska, 1993.
- APRS Implementation Team. 2000. Alien plants ranking system version 5.1. Jamestown, ND: Northern Prairie Wildlife Research Center Online. (Version 30SEP2002). Web site: <http://www.npwrc.usgs.gov/resource/literatr/aprs> (accessed January 2012).

Restore Altered Habitats and Reintroduce Native Plants

Restoration is critically important because the conditions responsible for the initial invasion will expose the site to a resurgence of the invasive species, as well as a secondary invasion of one or more different species. Furthermore, restoration of a disturbed area before the initial invasion may preclude the need for further control efforts. The goal is to conserve and promote natural processes that will inherently suppress potential pest populations (Department of the Interior 2007).

If funding or personnel are not available to restore highly disturbed areas in a timely manner, consider planting a cover crop for several years to stabilize the site prior to reintroducing native plants. This will prevent more invasive seeds from entering the environment until the site can be restored. Native plants can then be established by direct seeding or planting with less competition from invasive species in the seed bank. When practical, local genotypes of native species should be used.

Biological Control

Biological control is the use of animals or disease organisms that feed upon or parasitize the invasive species target. Usually, the control agent is imported from the invasive species' home country, and artificially high numbers of the control agent are fostered and maintained. There are also “conservation” or “augmentation” biological control methods where populations of biological agents already in the environment (usually native)

are maintained or enhanced to target an invasive species. The advantages of this method are that it avoids the use of chemicals and can provide relatively inexpensive and permanent control over large areas. Appropriate control agents do not exist for all invasive species. Petitions must be submitted to, and approved by, the USDA Technical Advisory Group on weed biological control before any proposed biological control agent can be released in the U.S..

Sometime around 2000, John Heinz NWR participated in USDA APHIS programs that resulted in a release of the purple loosestrife biological control *Galerucella* beetle at two sites within the refuge. The first release site, around Hoy's Pond, has resulted in reduction of loosestrife in this area. The second release within the Impoundment was not as successful due to water levels historically present within the impoundment. At this time, no plan exists to re-release new populations of *Galerucella*, but it should be explored in the near future in combination with potential biological controls for other invasive species (Phillips personal communication 2009).

The refuge biologist and manager should evaluate various biological control agents as they become available for field application for the invasive species documented across the refuge. Discussions with USDA APHIS staff may help provide an overview of available research, development of biological control agents, and potential for application of species-specific controls.

Manual and Mechanical Control

Mechanical removal of invasive organisms can be effective against some herbaceous plants, shrubs and saplings, and aquatic organisms. This is particularly effective for plants that are annuals or have a taproot. Care should be taken to minimize soil disturbance to prevent creating conditions ideal for weed seed germination. Repeated cutting over a growing period is needed for effective control of many invasive plant species. Care should be taken to properly remove and dispose of any plant parts that can re-sprout. Treatments should be timed to prevent seed set and re-sprouting. The following methods are available: hand-pulling, pulling with hand tools (weed wrench, etc.), mowing, brush-hogging, weed-eating, stabbing (cutting roots while leaving in place), girdling (removing cambium layer), mulching, tilling, smothering (black plastic or other), and flooding.

The advantages of mechanical treatment are low cost for equipment and supplies and minimal damage to neighboring plants and the environment. The disadvantages are higher costs for labor and inability to control large areas. For many invasive species, mechanical treatments alone are not effective, especially for mature plants or well-established plants. For some invasive plants, mechanical treatments alone exacerbate the problem by causing vigorous suckering. Mechanical treatments are most effective when combined with herbicide treatments (e.g., girdle and herbicide treatment).

Water Level Management in Impoundments

Water level management is also used to control invasive species and promote desirable plants. Robust plants such as *Phragmites* require air pockets (carbon dioxide) to survive. Flooding of impoundments throughout all (or part) of a growing season, inhibits or prohibits vegetative growth of robust vegetation, particularly after mowing or chemical application. Subsequent drawdown will allow for germination of moist-soil plants preferred by waterfowl. Timing and speed of drawdown affects species diversity, density, and seed production. Slow drawdown (4 to 8 weeks) early in the season creates greater species diversity, while fast drawdown (a few days to less than 2 weeks) results in lush extensive stands of similar vegetation. Late in the season, however, slow drawdown promotes greater diversity and density, whereas fast drawdown promotes undesirable plant composition (Lane and Jensen 1999). Flooding also promotes robust perennial control by muskrats.

Winter drawdowns are also possible, but should be avoided as they have detrimental effects on species overwintering in the impoundments such as invertebrates, reptiles, amphibians, and muskrats. Winter drawdowns have been shown to help control undesirable overpopulations of white water lily and carp, but managers should weigh this benefit with the potential costs before undertaking a winter drawdown.

Deer Control

As discussed in chapters 2 and 3, invasive plant problems often are exacerbated by white-tailed deer overbrowsing native species, and when deer numbers rise above the carrying capacity, biodiversity declines (NY State Department of Environmental Conservation 2007).

John Heinz NWR's proximity to high density residential neighborhoods, Philadelphia International Airport, Interstate 95, regional railways, and other public roads make public hunting a difficult option for control of deer populations at the refuge. Public hunting may be used to reduce the deer population only if it is logistically feasible, provides appropriate public safety and screening procedures, and is biologically efficient. An alternative for John Heinz NWR may be use of wildlife control specialists. While this prohibits the opportunity for a combination of public use and deer population management, it does ensure appropriate safety measures are taken. Wildlife control specialists in other highly urbanized settings around Philadelphia have been successful in controlling pest species. A combination of both approaches may be another consideration depending on resources available, public interest, and population targets. Deer control must be conducted in combination with other invasive plant control measures as deer control alone will not be effective if the invasive plants are already established.

Deer exclosures should be considered only in small highly sensitive areas (e.g., where invasive plants are out-competing rare plants and the rare plants will be extirpated without intervention). This method is labor intensive and costly to employ and should only be used on a very limited basis until the native community is firmly established and the invasive species are controlled.

Herbicides

There are a wide variety of chemicals that are toxic to plant and animal species. They may work in different ways and be very target specific, or affect a wide range of species. Herbicides may be "pre-emergent," that is, applied prior to germination to prevent germination or kill the seedling, or "post-emergent" and may have various modes of action (auxin mimic, amino acid inhibitor, mitosis inhibitor, photosynthesis inhibitor, lipid biosynthesis inhibitor). Products may come in granular, pelleted, dust, or liquid forms. Liquid herbicides are commonly diluted to an appropriate formula and mixed with other chemicals that facilitate mixing, application, or efficacy. Common application methods include foliar spray, basal bark, hack and squirt, injection, and cut stump. The timing of applications is critical to achieve good control, as the growth stage at which an organism will be most effectively controlled varies with different species.

The advantages are that the right chemicals, applied correctly, can produce desired results over a large area for a reasonable cost. The disadvantages are that the chemicals may affect nontarget species at the site (including the applicator) or contaminate surface or groundwater. Proper planning includes using the most target-specific, least hazardous (to both humans and the environment), and most effective chemical for the job. Additionally, one should research minimum effective dosage, as the chemical labels often give higher than necessary concentrations. Herbicides often are most effective when used in combination with mechanical methods described above.

Attention to protective gear, licensing requirements and other regulations is essential. In the Service, all pesticide and other chemical applications (including adjuvants designed to enhance effectiveness) are covered by Service and departmental regulations, and a Pesticide Use Proposal is required for all pesticide applications.

Control of Overabundant or Nonnative Waterfowl Populations

Controlling invasive or overabundant waterfowl, such as mute swans, snow geese, and resident population Canada geese is a strategy used to protect native waterbirds and fisheries, and prevent the destruction of wetland habitats on refuges. Control methods include: harassment, egg shaking, sterilization, and removal.

The Atlantic Flyway Council outlines the coordination of state and Federal wildlife agencies "to reduce mute swan populations in the Atlantic Flyway to levels that will minimize negative ecological impacts to wetland habitats and native migratory waterfowl and to prevent further range expansion into unoccupied areas." Target populations of mute swans vary by state and range from 0 to 500 free-flying birds (Atlantic Flyway Council 2003).

In the fall of 2005, the Service completed an Environmental Impact Statement that included a multifaceted approach for managing resident Canada geese. At the recommendation of the Atlantic Flyway Council, the Service approved the use of special regulations beginning in 2007 to help curb the growth of these geese in the Eastern U.S. included in this approach was the expansion of hunting methods during September seasons (USFWS 2005).

While neither mute swans nor resident Canada geese have been nuisances at John Heinz NWR, control options should be considered if at some point overabundant waterfowl begin to pose impacts to other species of conservation concern or components of BIDEH. The refuge manager should consider implementing appropriate population control measures as necessary.

Protecting Nesting Birds

The seasonal closure of nesting and foraging areas may be necessary to protect sensitive nesting bird species and habitats on the refuge, such as the bald eagle. Posting “no disturbance” or “area closed” signs near bird nesting areas, nesting islands, or individual nest locations, is one way to help prevent disturbance caused by humans and boats. Signs are placed in the appropriate areas as soon as possible in the spring and are maintained throughout the nesting season. If disturbance is noted by refuge staff, additional areas may be posted as well.

Impoundment Management

Water Level Manipulation

Water level management (timed drawdown and flooding) is a strategy used to mimic the dynamic water regime of some natural wetlands, and is typically timed to benefit shorebirds, wading birds, and/or waterfowl. During a draw down, mudflats and shallow waters areas are created to provide foraging habitat for shorebirds, while at the same time concentrating food for wading birds. Some waterfowl (e.g., teal) will also take advantage of the concentrated and more accessible food resources. Eventually, the soils in these mudflat areas begin to oxidize and warm up. This in turn causes moist-soil vegetation to germinate. If the water is removed early in the growing season, moist-soil vegetation will outcompete most perennial emergent vegetation, which requires warmer soil temperatures for germination. When water is removed later in the growing season, perennial emergent vegetation usually dominates. This is often an undesirable outcome of a drawdown and is usually avoided. As moist-soil annual vegetation grows, shallow (not to exceed 1/3 plant height) flooding can be used to irrigate growing vegetation, create shallow water foraging habitat for waterfowl or discourage growth of perennial or invasive plants. Water levels are usually returned to the desired management level prior to fall migration, or the following spring migration if water is not available in the fall. Generally, slow (over several weeks) drawdowns will provide a greater diversity of moist-soil plants than faster (over a few days) drawdowns (Frederickson and Taylor 1982).

Alternatively, drawdowns may occur in fall to provide foraging habitat for fall migrating shorebirds and some waterfowl. Winter drawdowns are also possible, but should be avoided as they have detrimental effects on species overwintering in the impoundments such as invertebrates, reptiles, amphibians, and muskrats. Winter drawdowns have been shown to help control undesirable overpopulations of white water lily, but managers should weigh this benefit with the potential costs before undertaking a winter drawdown.

Water may also be held in an impoundment over the growing season, or several growing seasons, to provide breeding habitat for waterfowl and marsh birds. This is usually done in areas where a healthy perennial emergent component exists in the wetland. Over time, water stress or muskrat activity will often reduce the amount of emergent vegetation until it is no longer a significant component of the impoundment. At this point the impoundment has little value to breeding waterfowl and marsh birds and another drawdown should be considered.

Vegetation Management

Plants that occur in an impoundment can be either desirable or undesirable based on their value to wildlife. Generally, plants that provide cover, energy, or nutritional value for objective wildlife are desirable. Plants that

quickly develop monocultures and impede foraging by wildlife are undesirable. Whether a plant is desirable or not also depends on why the impoundment is being managed. For example, cattail is undesirable to shorebirds and waterfowl because it forms dense monotypic stands, and reduces foraging habitat (mudflats and moist-soil vegetation) of shorebirds and waterfowl. In contrast, it provides cover and breeding habitat for marsh birds, and therefore is desirable if managing for those species. The challenge of impoundment management is balancing the needs of various wildlife guilds. In addition to the water level manipulation techniques listed in the previous paragraphs, below are available strategies for promoting desirable vegetation and controlling undesirable or invasive plants.

Muskrat Population Management

Musk rats are efficient at reducing the cover of robust perennial vegetation. The impoundment should be held high for at least 1 year, and muskrat trapping in the impoundment interior should be prohibited when the cover of robust perennial vegetation needs to be decreased. However, if perennial vegetative cover is lower than desired, muskrat control should be conducted. Muskrat trapping also should be employed when muskrat numbers are high enough to damage impoundment dikes or water control structures. Trapping of muskrats takes place during the fall and winter, during State-established trapping seasons. Muskrat trapping follows State regulations and refuge-specific regulations and is issued through a special use permit. See the refuge trapping plan for more information.

Mowing

Mowing can be used to reduce plant height and deplete energy reserves of invasive and robust plants. Repeated mowing within a growing season is often necessary to successfully control invasive plants. This can be logistically difficult in a habitat that is managed for various resources of concern. However, mowing can be effective when combined with other strategies, such as chemical treatment, spring flooding, and disking. Timing of mowing should be scheduled to occur when the undesirable plants are at maximum above ground energy reserve and have little potential for seed dispersal. This is usually the point between flowering and seed setting. Mowing may also increase plant diversity by creating space (light) for other species to germinate.

Due to the unconsolidated nature of sediments deposited within the bed of the impoundment, mowing is not a likely option for vegetation management in most cases. However, there may be occasional opportunities for mowing and cutting in portions of the impoundment fringe. Accessibility and stability should be carefully considered prior to mowing treatments.

Herbicide

The most commonly used herbicide for controlling invasive and robust vegetation in impoundments is glyphosate. Methods of application include spot-treatment using backpack or ATV mounted sprayer, or aerial application. Spot-treatment is more targeted (avoiding neighboring plants), but can be very labor intensive when treating large areas. Aerial application is less labor-intensive, but is not as target-specific, and requires extensive planning to execute. Herbicides are applied during flowering and prior to seed set to maximize effectiveness.

Seeding and Planting

Most impoundments contain abundant stock of moist-soil plant seeds native to a locality, therefore making seeding and planting unnecessary (Frederickson and Taylor 1982). These seeds may remain viable in the soil for many years, and germinate under suitable environmental conditions (Lane and Jensen 1999). In extreme circumstances, past human activities (such as extensive herbicide use, prolonged flooding, and promoting monotypic plants for many years) may have altered site conditions such that the soil seed bank is inadequate or nonexistent (Weller 1990). In these situations, the seed bank may need to be augmented through planting of seeds, rhizomes, or seedlings to ensure growth of desirable plants. Only native species should be used for seeding and planting. Whenever possible, seeds and other plant material should be obtained from a local reference site, either through direct seed harvest or transplant, or from a nursery that procured their stock locally.

Beaver Control

Because beavers are part of the natural landscape, and can be beneficial in terms of creating wetland habitats, harvest of nuisance beavers will only be conducted when negative impacts are determined to be excessive. Beavers interfere with impoundment management by damaging or clogging water control structures and altering water levels on surrounding lands so impoundments either cannot be filled or cannot be drained. Whenever possible, water control structures and drainage pipes should be fitted with guards to prevent beavers from clogging the pipes or damaging the structures. Trapping is the most effective method of removing problem beavers and may be conducted either during fur season or by nuisance trappers during other times of the year.

Impoundment Improvement Through Depression Creation

Impoundments are created when an ecological system has been altered and the hydrology has been modified and cannot be restored by other means due to surrounding land uses. Impoundments are managed to mimic natural hydroperiods or to provide the best possible habitat for high-priority wildlife species. Impoundments that do not provide high quality habitat, should be modified to achieve the refuge's highest priority habitat goals and objectives.

Annual and perennial wetland vegetation establishment within impoundments is dependent on site elevation relative to hydrology (inundation or saturation levels). In impoundments with little or no change in bathymetric elevation, enhancing the gradient of elevation changes may be a suitable technique for habitat enhancement. Due to the degree of habitat degradation and the lack of wildlife use, it is beneficial to create depressions to restore these areas to high-quality wetland habitat. Depressions will create a mix of emergent marsh and open water habitat that will improve biological diversity and productivity.

Depressions should be created by physically removing material. Other methods that leave the material onsite create temporary openings that fill in as the displaced muck slumps back in and cattails re-invade. Material should be removed to create open water areas and channels in an irregular pattern. The irregular pattern visually attracts wildlife and creates more edge and interspersed vegetation between open water and emergent vegetation. The finished bottom of all excavations should be 6 to 36 inches lower than the managed water level of the rest of the impoundment. A meandering channel should connect the newly created depressions to the rest of the impoundment, thus permitting water flow and water level management by the same structures used to control water levels in the surrounding impoundment. A minimum of 50 percent of the side slopes of the depressions should be at a grade of 6:1 (6 horizontal to 1 vertical) or flatter. Slopes as flat as 10:1 are preferable if possible. The remaining side slope area should have a grade of 3:1 or flatter. The connecting ditches should have side slopes of 2:1 or flatter. Excavated muck should be spread over a nearby upland area on the refuge (Sheila Hess, personal communication, October 2005; USDA-NRCS 2006a).

Construction should be planned for the winter when the ground is frozen or the summer following a spring drawdown when earth moving equipment is least likely to sink in the unconsolidated muck. At John Heinz NWR, the soft substrate of the impoundment bed has prohibited access by most equipment. Additionally, portions of the impoundment are used by red-bellied turtles for winter hibernation. Consideration of these sites needs to be incorporated into any enhancement plan.

Forest Management

Silvicultural Prescriptions

Active management generally has not historically been necessary to maintain forest communities in John Heinz NWR. However, communities such as the coastal plain forest, dominated by oak and sweetgum, may require occasional clearing and thinning in order to promote regeneration of these shade-intolerant canopy species.

If a forested tract is degraded and not meeting habitat objectives, then a silvicultural prescription may be needed. A silvicultural prescription is a detailed set of written instructions for the treatment of a forested property and should be developed prior to the treatment of forested tracts other than invasive species treatments (Adams and Dwyer 2012). A forester should be consulted to develop a prescription based on the site conditions and habitat objectives identified in the HMP.

Forest Establishment and Reforestation

Patch size and distribution on the landscape are important considerations in planning and managing habitats. Forest restoration at John Heinz NWR, as outlined in the HMP should be focused on conversion of existing grassland areas, or exotic species-dominated forest, to a coastal plain forest community. Forest restoration to a floodplain forest community is also appropriate along rivers and open water as riparian forest corridors are often more diverse than adjacent upland areas despite occupying a small area. These areas should be chosen based on their juxtaposition to currently existing forested tracts.

In grassland and meadow areas, forests may be established by allowing the area to succeed naturally; seeding herbaceous, shrub, and tree species; planting shrub and tree seedlings or saplings; or by a combination of these methods. Shade-tolerant herbaceous species may need to be seeded or planted after a canopy is established as they may not survive full sun conditions. The plants in the surrounding landscape should be surveyed to determine the seed stock. If desirable species are in the surrounding landscape and the invasive species load is low, then natural succession should be allowed to proceed. Invasive or other undesirable species can be selected out with herbicides. It may be desirable to plant only those species that are not already present in the surrounding landscape.

If the area is surrounded by invasive species, then allowing natural succession without seeding or planting natives likely will not be successful. Planting seeds of native species is less expensive than planting seedlings or saplings, but it will take longer for these to become established. A combination of seeding and planting may be the best strategy to “flood” the site with natives to outcompete surrounding invasives. The seedlings and saplings will produce seeds and provide shade more quickly, and the planted seeds will provide competition for invasive seeds already present in the soil. The site must be monitored, and invasive species must be controlled before they become well-established. The invasives in the surrounding landscape also should be controlled as resources permit.

Whenever nursery shrubs and trees are planted, they should be protected from deer and other herbivores. Selection of species and ecotypes is a critical step in seeding and restoration. Using local seed and plant materials is important in restoration as plants have wide genetic diversity across geographic space.

Grassland Management

As noted within the HMP, John Heinz NWR does not have grasslands of large enough size to support breeding sites for many grassland birds. Instead, these habitats tend to provide stopover foraging habitat. Refuge grasslands consist of both cool-season and warm-season grasses. Cool-season grasses start growing in spring as soon as the snow melts and the days start to warm up. They grow best in spring and fall and tend to stop growing during the hot dry days of summer. They are usually relatively short and do not grow as dense as many warm-season grasses. Conversely, warm-season grasses do not start growing until late spring and grow best during the hot dry summer months. They generally grow taller and denser than cool-season grasses.

Currently, most cool-season grasses within John Heinz NWR are exotic species brought over from Europe as forage for livestock. Most warm-season grasses are native to the North American prairie. Some varieties are native to Pennsylvania’s historic grasslands and the Northeast as well. Exotic cool-season and native warm-season grasses are readily available from seed companies across the country. Some seed companies are beginning to propagate native cool-season grasses, making them more available for planting, but still at a relatively high price.

Many species of grassland birds require relatively large blocks of habitat for nesting areas. Some species, such as upland sandpiper and Henslow’s sparrow are not likely to be found in grassland patches of less than 75 acres. Other species patch size requirements are smaller, but grasslands of less than 25 acres generally do not meet the requirements for most grassland nesting birds and may be better suited to a different habitat type (e.g., shrubland) (Mitchell et al. 2000).

Historically, most of the Northeast was forested, except for a period following European settlement when much of the region was cleared for agriculture and subsequently grasslands and open fields became abundant. In

pre-settlement times, permanent, large openings were uncommon, except for selected coastal areas. Scattered openings occurred along large river floodplains, around beaver flowages, in coastal heathlands and in other areas of regular disturbance. Large grasslands are now in decline and the region is becoming more forested (Rothbart and Capel 2006).

Populations of grassland birds are declining as grassland habitats and other agricultural conditions diminish. Norment (2002) notes that despite the relatively recent (last 200 years) rise and fall of grassland habitats and associated birds in New England, the region may still be important for these species given their continental decline and habitat loss in the core of their ranges in the Midwest. While grasslands of John Heinz NWR are not sizable enough to provide suitable breeding habitat, they can be managed to improve their BIDEH and provide quality habitat for species migrating through the refuge.

Mowing

Mowing (or cutting) is very effective at controlling broad leaf forbs and woody species, provided it occurs during the growing season of these plants. Mowing is especially effective in supporting weed control efforts associated with new grassland seeding and establishment. Cutting should be delayed until after the nesting season of most grassland birds (usually mid-July) but should be done as soon as possible after this date to allow for maximum stress on invading forbs and shrubs. Depending on the amount of forb and shrub invasion, some grassland fields may require repeated cutting during any one season. Cutting should be done often enough to keep the grassland in the intended state. Occasionally it is possible to selectively mow small sections of forb and tree encroachment within larger grassland fields, thus saving the refuge resources and reducing disturbance to the grassland as a whole.

Prescribed Fire

If used properly, fire can be a useful tool for maintaining grasslands. Generally, prescribed fire is suitable for controlling woody species and to a lesser extent broad leaf forbs in warm-season grasslands. Cool-season grasslands are difficult to maintain with prescribed fire. To achieve effective control of woody species, fire must be applied late enough in the growing season to allow these species to leaf out, but early enough to ensure that sprouting warm-season grasses are not damaged. Due to the early season growth habits of cool-season grasses, they are often too green to allow a fire during the time when woody plants have leafed out.

Due to health constraints related to urban air quality, as well as safety concerns for Philadelphia International Airport, Interstate 95, and regional rail, fire is an unlikely management tool for applications at John Heinz NWR. Despite these constraints, the refuge manager should have an understanding of fire ecology and its place within the habitats of the refuge and suitable alternatives for management.

Herbicides

Woody plants or broadleaf forbs can be sprayed with herbicide during the growing season to control their spread within grassland habitat. Herbicides can either be specific to a certain type of plant (e.g., dicamba for broad leaf plants) or general (e.g., glyphosate). Herbicides can also be sprayed on individual plants, such as from a backpack sprayer, or broadcast across the grassland, such as from a boom sprayer. The species being controlled and the amount of invasion into the grassland will determine which herbicide is used and how it is applied.

The sensitive nature of many refuge habitats and species dictate that herbicides are used with extreme care. It is illegal to use an herbicide in a manner inconsistent with the label, but refuges should strive to be even more restrictive with their use. Nonchemical management techniques should be considered before deciding to use herbicides. Unfortunately, chemical control is often the only effective control technique available for certain plants, particularly many invasive species. Refuges should select the most benign chemical available to effectively do the job and apply it at the minimum necessary rate.

Grassland Establishment

As stated above, patch size and distribution on the landscape are important considerations in planning and managing habitats. Some cool-season grass dominated meadows of John Heinz NWR can be enhanced through establishment of native warm-season grasslands.

Seeding and planting desirable plants can be used to enhance existing grasslands, in restoration of degraded grasslands, or in conversion of croplands. Selection of species and ecotypes is a critical step in seeding and restoration. While many species are commercially available for grassland restoration, few are native to the Northeast. Using local seed and plant materials is important in restoration as plants have wide genetic diversity across geographic space.

Initial seedbed preparation to decrease the weed seed bank is critical to successful grassland establishment. Former agricultural fields are ideal sites for grassland establishment if weed problems are already under control. The field should only need to be disked or sprayed with herbicide in spring prior to seeding as soon as the soil is dry enough.

In fallow fields, a controlled burn the summer or fall prior to seeding decreases surface weed seeds and litter. By the following March or April, spring disking or tilling will reduce the number of winter-growing weeds which set seed. The area should be left fallow during summer and tilled or sprayed with herbicide (glyphosate or pre-emergent herbicide), as necessary, to eliminate late-germinating weeds. One advantage of this spring-summer fallow technique is that deep soil moisture is conserved for the following fall planting. Finally, seedbed preparation may require smoothing with a land plane or scraper and roller if soil clods are large. Rolling with a ring roller provides compaction that will maintain good soil moisture following the first rains.

Broadcast seeding followed by shallow harrowing and cultipacking is very effective, especially on well-prepared soil. A small flexible tine harrow (Fuerst) can be pulled by a standard ATV to easily and rapidly harrow soil to cover the broadcast seed. In small or inaccessible areas, four pronged cultivator rakes can be used to agitate the soil and cover the seed. The preferred method of seeding warm-season grasses is with a no-till drill. When using a drill in recently tilled seedbeds, it is best to cultipack the tilled soil before seeding. Whether drilling or broadcasting on tilled soil, it is essential to cultipack after seeding. It is further recommended to cultipack twice after broadcasting, with the second cultipacking 90 degrees from the first (USDA- NRCS 2006b).

Because warm-season grasses are slow to germinate and have less seedling vigor than cool-season grasses, weed and sod control, both before and after planting, is much more critical than when establishing cool-season grasses. For establishing warm-season grasses, weed control throughout the growing season is just as critical as it is before planting. It usually takes at least two growing seasons to establish a warm-season grass stand which makes weed control during the first growing season critical. Because warm-season grasses are not shade-tolerant, weed canopies will reduce seedling vigor. Moisture competition from weeds and cool-season grasses may also further reduce seedling vigor (NRCS-USDA 2006).

To establish warm-season grasses, weeds are usually controlled by clipping with a sicklebar mower set at a height where only the leaf tips of the warm-season grass seedlings are cut, and the growing point is not damaged. This will reduce the shading competition but not hurt the emerging seedlings. Mowing weeds before flowering will prevent seed production. Mowing two to three times may be necessary during the establishment year; however, if clipped too frequently, weeds may “stool out” (grow out instead of up) (NRCS-USDA 2006).

Appendix B References

- Adams, J. and J. Dwyer. Silvicultural Prescriptions. Handouts for Master Tree Farmer II Session 2, Talk 1. Southern Regional Extension Forestry. Accessed January 2012. [Online version available at <<http://www.sref.info/courses/mtf2/mtf2-2-1.pdf>>].
- Anonymous, Montana Weed Mapping Handbook: Montana Noxious Weed Survey and Mapping System (Version 2.0), undated.
- Atlantic Flyway Council. 2003. Atlantic Flyway Mute Swan Management Plan 2003-2013. Accessed January 2012. [Online version available at <http://www.michigan.gov/documents/dnr/AFC_mute_swan_plan1_364878_7.pdf>]
- Baldassarre, G.A. and E.G. Bolen. 1994. Waterfowl Ecology and Management. John Wiley and Sons, Inc., New York, NY.

- Department of the Interior. 2007. Departmental Manual; Environmental Quality Programs; Part 517: Pesticides: Chapter 1: Integrated Pest Management Policy. Office of Environmental Policy and Compliance, Washington D.C.
- Frederickson, L.H. and D.L. Batema. Greentree Reservoir Management Handbook. Gaylord Memorial Laboratory. The School of Natural Resources, University of Missouri-Columbia, Puxico, MO.
- Fredrickson, L.H. and T.S. Taylor. 1982. Management of seasonally flooded impoundments for wildlife. U.S. Fish and Wildlife Service Resource Publication.
- Fulfilling the Promise National Invasive Species Management Strategy Team. 2002. The National strategy for management of invasive species. National Wildlife Refuge System.
- Gruchy, J.P. and C.A. Harper. 2006. When is the best time to disk native warm-season grasses for wildlife? In Proceedings of the Fifth Eastern Native Grass Symposium (Matt Sanderson ed.) Omnipress, Madison, WI.
- Hess, S. 2005. Personal communication.
- Lane, J.J. and K.C. Jensen. 1999. Moist-soil impoundments for wetland wildlife. U.S. Army Corps of Engineers Technical Report EL-99-11.
- Lowry, D.J. 1990. Restoration and creation of palustrine wetlands associated with riverine systems of the glaciated northeast. In Wetland Creation and Restoration: The Status of Science (J. A. Kusler and M. E. Kentula, eds.). Island Press, Washington, D.C.
- Mitchell, L.R., C.R. Smith, and R.A. Malecki. 2000. Ecology of Grassland Breeding Birds in the Northeastern United States- A Literature Review with Recommendations for Management. US Geological Survey, New York Cooperative Research Unit, Department of Natural Resources, Cornell University.
- Mitchell, W.A. and C.J. Newling. 1986. Greentree Reservoirs: Section 5.5.3, US Army corps of Engineers Wildlife Resources Management Manual. Department of the Army, Vicksburg, MS.
- New York State Department of Environmental Conservation. 2007. New York hunting and trapping 2007-08 official regulations guide. NY State Department of Environmental Conservation, Albany, NY.
- Niering, W.A. and R.H. Goodwin. 1974. Creation of Relatively stable shrublands with herbicides: arresting "succession" on rights-of-way and pastureland. Ecology 55:784-795.
- Norment, C.J. 2002. On grassland bird conservation in the Northeast. Auk 119:271–279.
- Rothbart, P. and S. Capel. 2006. Maintaining and Restoring Grasslands. In Managing grasslands, shrublands, and young forest habitats for wildlife. A guide for the northeast (J.D. Ohler, D.F. Covell, S. Capel, and B. Long, eds.). The Northeast Upland Habitat Technical Committee. Massachusetts Division of Fisheries and Wildlife
- Sample, D.W. and M.J. Mossman. 1997. Managing habitat for grassland birds: a guide for Wisconsin. Wisconsin Department of Natural Resources Publication No. SS-925-97.
- Sepik, G.F., R.B. Owen, and M.W. Coulter. 1981. A Landowner's Guide to Woodcock Management in the Northeast. Misc. Report No. 253. University of Maine, Orono, ME.
- USDA-NRCS. 1999. Natural Resources Conservation Service Conservation Practice Standard: Pothole. New York.

- USDA-NRCS. 2006a. Natural Resources Conservation Service Wetland Restoration – 774 Pothole. New York.
- . 2006b. Warm-season Grasses in Pennsylvania. Harrisburg, PA.
- U.S. Fish and Wildlife Service (USFWS). 2005. Final Environmental Impact Statement: Resident Canada Goose Management. Accessed January 2012. [Online version available at <<http://www.fws.gov/migratorybirds/CurrentBirdIssues/Management/cangeese/finaeis>>]
- Weller, M.W. 1990. Waterfowl management techniques for wetland enhancement, restoration and creation useful in mitigation procedures. In *Wetland creation and restoration: The status of the science*. (J.A. Kusler and M.E. Kentula, eds.). Island Press, Washington, D.C.
- Williams, R.K. Construction, maintenance, and water control structures of tidal impoundments. In *Waterfowl Habitat Restoration Enhancement and Management in the Atlantic Flyway* (W. R. Whitman, T. Strange, L. Widjeskog, R. Whittemore, P. Kehoe, and L. Roberts eds.). Delaware Department of Natural Resources and Environmental Control, Dover, DE.
- Zimmerman, J.L. 1988. Breeding season habitat selection by the Henslow's sparrow in Kansas. *Wilson Bulletin* 100(1):17-24.

Appendix C. Resources of Concern for John Heinz NWR

Species	Seasons/Abundance at John Heinz NWR ¹				Nesting ¹	Federal T&E ²	PA T&E ³	BCR 30 ⁴	PIF 44 ⁵	USFWS North Atlantic LCC Priority List ⁶	USFWS Birds of Conserv. Concern ⁷	Federal Trust Fish	PA SWAP Priority ⁸	North Atlantic Shorebird Plan ⁹	North American Waterbird Plan ¹⁰	Waterfowl Management Plan ¹¹
	Spr	Sum	Fall	Win												
Waterbirds																
American Bittern	c	r	o	r	Y		PE	M	2		X		HC			
American Coot	c	o	c	o	Y								MC			
Black Tern	o	r	o				PE								M	
Black-crowned Night Heron	a	a	a	o	Y		PE	M					V		M	
Bonaparte's Gull	o	r	o	r											M	
Caspian Tern	o	r	o						5						L	
Cattle Egret	o	o	r												NR	
Common Gallinule	u	u	u	r	Y				5				MC			
Common Tern	r	r	r				PE	M					V		L	
Double-crested Cormorant	c	r	c	r											NR	
Forster's Tern	r	o	c						5						M	
Glaucous Gull	r		r	r											NR	
Glossy Ibis	o	o	o					H	5						L	
Great Blue Heron	a	c	a	c					5				MC		NR	
Great Egret	a	a	a	r	Y		PE		5				V		NR	
Gull-billed Tern			r					HH	2	X	X				H	
Herring Gull	c	o	c	c											L	
Horned Grebe	r		r	r				H			X					
Iceland Gull	r		r	r											L	
King Rail	o	o	o	r	Y		PE	M	1B				V			
Laughing Gull	o	o	c	r											NR	
Least Bittern	o	c	o		Y		PE		2		X		V			
Least Tern	r	r	r					H	2		X				H	
Little Blue Heron	o	c	c					M	5						H	
Northern Gannet			r	r				H							NR	
Pied-billed Grebe	c	r	c	o	Y				5		X		MC			

Species	Seasons/Abundance at John Heinz NWR ¹				Nesting ¹	Federal T&E ²	PA T&E ³	BCR 30 ⁴	PIF 44 ⁵	USFWS North Atlantic LCC Priority List ⁶	USFWS Birds of Conserv. Concern ⁷	Federal Trust Fish	PA SWAP Priority ⁸	North Atlantic Shorebird Plan ⁹	North American Waterbird Plan ¹⁰	Waterfowl Management Plan ¹¹
	Spr	Sum	Fall	Win												
Red-throated Loon			r	r			HH				X					
Ring-billed Gull	c	o	c	c											NR	
Royal Tern			r				M	5							M	
Snowy Egret	a	a	a		Y		M				X				H	
Sora	o	o	o	r	Y		M						MC			
Tricolored Heron	o	o	o				M	5							H	
Virginia Rail	o	o	o	r	Y								HC			
White Ibis	r		r												M	
Yellow-crowned Night Heron	r	r	r				PE	M	5				V		M	
Waterfowl																
American Black Duck	a	c	a	c	Y		HH	1B	X				MC			D
American Wigeon	o		o	o			M									I
Blue-winged Teal	c	c	c	r	Y											I
Brant	r		r	r						X						
Bufflehead	o		o	r			H									I
Canada Goose	a	a	a	c	Y					X						
Canvasback	o		o	r			H									I
Common Goldeneye	r	r	r	r			M									
Common Merganser	o		o	o												I
Gadwall	o	r	o	o			M									I
Greater Scaup	c	r	o	o			H									I
Green-winged Teal	c	o	a	c	Y		M						V			I
Hooded Merganser	o	r	o	r	Y		M									I
Lesser Scaup	o		o	o			H									D
Mallard	a	a	a	c	Y		H									NT
Northern Pintail	c	o	c	c	Y		M									D

Species	Seasons/Abundance at John Heinz NWR ¹				Nesting ¹	Federal T&E ²	PA T&E ³	BCR 30 ⁴	PIF 44 ⁵	USFWS North Atlantic LCC Priority List ⁶	USFWS Birds of Conserv. Concern ⁷	Federal Trust Fish	PA SWAP Priority ⁸	North Atlantic Shorebird Plan ⁹	North American Waterbird Plan ¹⁰	Waterfowl Management Plan ¹¹
	Spr	Sum	Fall	Win												
Northern Shoveler	c	r	c	o	Y											I
Red-breasted Merganser	o		r	r				M								I
Redhead	r	r	r	r												NT
Ring-necked Duck	o	r	o	o												I
Ruddy Duck	c	o	c	c				M					MC			I
Tundra Swan	r		r	r				H					R			
Wood Duck	a	c	a	o	Y			M								I
Landbirds																
Acadian Flycatcher	r	r	u						1B				MC			
Alder Flycatcher	o	o	u		Y								MC			
American Kestrel	c	c	c	c	Y				2							
Bald Eagle	u	r	u	u	Y		PT	M	5		X		HC			
Bank Swallow	c	o	c						5				MC			
Barn Owl	c	c	c	c	Y		CR		2				MC			
Barred Owl	r	r	r	r					5							
Bay-breasted Warbler	c	r	c					H		X	X					
Black-and-white Warbler	c	r	c	r				H								
Black-billed Cuckoo	o	o	o		Y								MC			
Blackburnian Warbler	c	r	c					M					MC			
Blackpoll Warbler	c	r	c				PE						V			
Black-throated Blue Warbler	c	r	c										MC			
Black-throated Green Warbler	c	r	c										MC			
Blue-winged Warbler	o	o	o					HH	1B	X	X		R			
Bobolink	o	r	c						5							
Brewer's Blackbird			r	r												

Species	Seasons/Abundance at John Heinz NWR ¹				Nesting ¹	Federal T&E ²	PA T&E ³	BCR 30 ⁴	PIF 44 ⁵	USFWS North Atlantic LCC Priority List ⁶	USFWS Birds of Conserv. Concern ⁷	Federal Trust Fish	PA SWAP Priority ⁸	North Atlantic Shorebird Plan ⁹	North American Waterbird Plan ¹⁰	Waterfowl Management Plan ¹¹
	Spr	Sum	Fall	Win												
Broad-winged Hawk	o	o	c	r				H					MC			
Brown Creeper	c		c	c												
Brown Thrasher	c	c	c	o	Y			H	2				MC			
Canada Warbler	c	r	c					M		X	X		MC			
Cerulean Warbler	r	r	r					M	1B		X		HC			
Chimney Swift	c	c	c					H	2				MC			
Cliff Swallow	o	r	o						5							
Common Nighthawk	c	o	c										MC			
Cooper's Hawk	o	r	o	o					5							
Dickcissel	r	r	r	r					3				HC			
Eastern Kingbird	c	c	c		Y			H								
Eastern Meadowlark	o	r	o	r									MC			
Eastern Wood Pewee	o	r	o						1B							
Field Sparrow	c	o	c	c	Y			H	2							
Golden Eagle	r		r	r									V			
Golden-winged Warbler	r	r	r					M			X		HC			
Grasshopper Sparrow	r		r					M					MC			
Gray Catbird	c	c	c	o	Y			M	2							
Great Crested Flycatcher	o	r	o		Y			H								
Henslow's Sparrow	r		r						1B		X		HC			
Kentucky Warbler	r	r	u					H	1B		X		MC			
Loggerhead Shrike	r	r	r	r			PE		5		X		IC			
Long-eared Owl	r		r	r									HC			
Louisiana Waterthrush	r	r	u					H	1B				R			
Marsh Wren	c	c	c	r	Y		CR	H					HC			

Species	Seasons/Abundance at John Heinz NWR ¹				Nesting ¹	Federal T&E ²	PA T&E ³	BCR 30 ⁴	PIF 44 ⁵	USFWS North Atlantic LCC Priority List ⁶	USFWS Birds of Conserv. Concern ⁷	Federal Trust Fish	PA SWAP Priority ⁸	North Atlantic Shorebird Plan ⁹	North American Waterbird Plan ¹⁰	Waterfowl Management Plan ¹¹
	Spr	Sum	Fall	Win												
Northern Bobwhite	r	r	r	r				H	2				IC			
Northern Flicker	c	c	c	o	Y			H								
Northern Goshawk	r		r	r									V			
Northern Harrier	c	o	c	c	Y		CA		5				HC			
Northern Oriole	c	o	c	r	Y			H								
Olive-sided Flycatcher	r		u								X		IC			
Osprey	o	o	o				PT		5				V			
Peregrine Falcon	r	r	r	r			PE		5		X		HC			
Pine Siskin	r	r	o	o									V			
Prairie Warbler	c	r	c					HH	1B	X	X		MC			
Prothonotary Warbler	r	r	u					H	1B				HC			
Red Crossbill				r									V			
Red-headed Woodpecker	r	r	r					M	2		X					
Red-shouldered Hawk	o	r	o	o					5				MC			
Rusty Blackbird	c	r	c	o				H			X					
Savannah Sparrow	c	r	c	r	Y				5							
Scarlet Tanager	c	r	c					H	2				R			
Sedge Wren	r	r	r		Y		PE	M	1B		X		IC			
Sharp-shinned Hawk	o	r	o	r									MC			
Short-eared Owl	o		o	o			PE	M	5		X		IC			
Summer Tanager	r	r	r										HC			
Swainson's Thrush	c	o	c								X		V			

Species	Seasons/Abundance at John Heinz NWR ¹				Nesting ¹	Federal T&E ²	PA T&E ³	BCR 30 ⁴	PIF 44 ⁵	USFWS North Atlantic LCC Priority List ⁶	USFWS Birds of Conserv. Concern ⁷	Federal Trust Fish	PA SWAP Priority ⁸	North Atlantic Shorebird Plan ⁹	North American Waterbird Plan ¹⁰	Waterfowl Management Plan ¹¹
	Spr	Sum	Fall	Win												
Vesper Sparrow	c	o	o	o					5							
Whip-poor-will	r	r	r					H			X		MC			
White-eyed Vireo	c	c	c		Y				1B							
Willow Flycatcher	c	c	u		Y								MC			
Winter Wren	o		c	r									MC			
Wood Thrush	c	c	c	r	Y			HH	1B	X	X		R			
Worm-eating Warbler	r	r	u					H	1B		X		R			
Yellow-bellied Flycatcher	r	r	u				PE						V			
Yellow-breasted Chat	c	c	c	r	Y				2				MC			
Yellow-throated Vireo	o	r	o					H	1B				MC			
Shorebirds																
American Woodcock	c	c	c	r	Y			HH		X			MC	X		
Black-bellied Plover	o	r	c	r				H								
Buff-breasted Sandpiper			r					H			X					
Common Snipe	c	r	c	o				M								
Dunlin	o		o	r				H								
Greater Yellowlegs	c	o	c	r				H								
Hudsonian Godwit			o					H			X					
Killdeer	a	a	a	o	Y			M								
Least Sandpiper	o	o	o	r				M								
Lesser Yellowlegs	o	o	o	r				M			X					
Marbled Godwit			r					H			X					
Piping Plover	r		r			E		HH	1A	X				X		

Species	Seasons/Abundance at John Heinz NWR ¹				Nesting ¹	Federal T&E ²	PA T&E ³	BCR 30 ⁴	PIF 44 ⁵	USFWS North Atlantic LCC Priority List ⁶	USFWS Birds of Conserv. Concern ⁷	Federal Trust Fish	PA SWAP Priority ⁸	North Atlantic Shorebird Plan ⁹	North American Waterbird Plan ¹⁰	Waterfowl Management Plan ¹¹
	Spr	Sum	Fall	Win												
Red Knot	r		r				HH			X	X			X		
Red-necked Phalarope	r		r							X						
Ruddy Turnstone	r	r	r				HH									
Sanderling	r		r				HH			X						
Semipalmated Plover	c	r	c				M									
Semipalmated Sandpiper	c	o	c	r			H			X	X					
Short-billed Dowitcher	o	r	o	r			H				X					
Solitary Sandpiper	c	o	c								X		MC			
Spotted Sandpiper	c	c	c		Y		M									
Upland Sandpiper	r	r	r				PT	M	1B		X		IC			
Western Sandpiper		r	o	r			M									
Whimbrel	r		r				HH			X	X			X		
White-rumped Sandpiper	o	o	o				H									
Willet	r		r				H	3								
Wilson's Phalarope	r	r	r				H									
Mammals																
Marsh rice rat	nc	nc	nc	nc			SX									
Northern river otter	nc	nc	nc	nc			CA						MC			
Amphibians																
Southern leopard frog	c	c	c	c	Y		PE						V			
Reptiles																
Eastern mud turtle	nc	nc	nc	nc	Y		PX									
Red-bellied turtle	u	u	u	u	Y		PT						HC			

Species	Seasons/Abundance at John Heinz NWR ¹				Nesting ¹	Federal T&E ²	PA T&E ³	BCR 30 ⁴	PIF 44 ⁵	USFWS North Atlantic LCC Priority List ⁶	USFWS Birds of Conserv. Concern ⁷	Federal Trust Fish	PA SWAP Priority ⁸	North Atlantic Shorebird Plan ⁹	North American Waterbird Plan ¹⁰	Waterfowl Management Plan ¹¹
	Spr	Sum	Fall	Win												
Fish																
American eel	p	p	p	p								X	MC			
Alewife	p	p	p	p						X		X				
Blueback Herring	p	p	p	p								X				
Eastern mudminnow	p	p	p	p			CR									
Hickory shad	p	p	p	p			PE					X				
Striped Bass	p	p	p	p						X		X				
Shortnose sturgeon	nc	nc	nc	nc		E	PE			X		X	IC			
Plants																
Waterhemp Ragweed	p	p	p	p			PR					X	MC			
Field Dodder	p	p	p	p			PT									
Walter's Barnyard-grass	p	p	p	p			PE									
A Eupatorium	p	p	p	p												
Forked Rush	p	p	p	p			PT									
Shrubby Camphor-weed	p	p	p	p						X		X				

Sources

¹ U.S. Fish and Wildlife Service. John Heinz NWR at Tinicum Web site. Available online at: <http://www.fws.gov/heinz/index.html>; accessed January 2012. a - abundant; c - common; u - uncommon; o - occasional; r - rare; nc - not confirmed on refuge, but potential habitat; p - present (from surveys) but seasonal abundance unknown

² U.S. Fish and Wildlife Service. Endangered Species Program Web site. Available online at: http://ecos.fws.gov/tess_public/pub/listedAnimals.jsp; accessed January 2012. E - Endangered; T - Threatened; R - Rare

³ Pennsylvania Fish and Boat Commission. The Pennsylvania Code, Chapter 75: Endangered Species. Available online at <http://www.pacode.com>; accessed March 2012.

Pennsylvania Game Commission. Threatened and Endangered Species Web site. Available online at <http://www.portal.state.pa.us>; accessed March 2012.

Pennsylvania Natural Heritage Program. Pennsylvania Natural Heritage Program Web site. Available online at: <http://www.naturalheritage.state.pa.us/>; accessed January 2012.

PE - Endangered; PT - Threatened; PR - Rare; PX/SX - Extirpated; CA - Candidate at Risk; CR - C

⁴ U.S. Fish and Wildlife Service. 2008. New England Mid-Atlantic Coast Bird Conservation Region (BCR 30) Implementation Plan. Atlantic Coast Joint Venture, Hadley, MA: Region 5, Fish and Wildlife Service, U.S. Department of the Interior. http://www.acjv.org/BCR_30/BCR30_June_23_2008_final.pdf; accessed January 2012. HH - Highest Priority; H - High Priority; M - Moderate Priority

⁵ Partners in Flight. April 1999. Partners in Flight: Mid-Atlantic Coastal Plain Bird Conservation Plan (Physiographic Area #44) Version 1.0. Williamsburg, VA. Prioritization Rankings = 1 (Highest) - 5 (Lowest).

⁶ U.S. Fish and Wildlife Service. December 2009. North Atlantic Landscape Conservation Cooperative Development and Operations Plan. U.S. Department of Interior, U.S. Fish and Wildlife Service, Northeast Region. Hadley, MA. 38 pp.

⁷ U.S. Fish and Wildlife Service. 2008. Birds of conservation concern 2008. Division of Migratory Bird Management, Arlington, Virginia. 93 pp. Online version available at: <http://www.fws.gov/migratorybirds/NewReportsPublications/SpecialTopics/BCC2008/BCC2008.pdf>; accessed January 2012.

⁸ Pennsylvania Game Commission/Pennsylvania Fish and Boat Commission. Accessed December 2008. State Wildlife Action Plan. Available online at <http://www.portal.state.pa.us/portal/server.pt?open=514&objID=622722&mode=2>; accessed January 2012. IC - Immediate Concern (Tier 1); HC - High Level Concern (Tier 2); R - Responsibility Species (Tier 3); V- Vulnerable Species (Tier 4); MC - Maintenance Concern (Tier 5)

⁹ Clark, K.E., L.J. Niles, and the North Atlantic Shorebird Habitat Working Group. 2000. U.S. Shorebird Conservation Plan: North Atlantic Regional Shorebird Plan Version 1.0. <http://www.fws.gov/shorebirdplan/RegionalShorebird/downloads/NATLAN4.pdf>; accessed January 2012.

¹⁰ Kushlan, J.A., M.J. Steinkamp, K.C. Parsons, J. Capp, M.A. Cruz, M. Coulter, I. Davidson, L. Dickson, N. Edelson, R. Elliot, R.M. Erwin, S. Hatch, S. Kress, R. Milko, S. Miller, K. Mills, R. Paul, R. Phillips, J.E. Saliva, B. Sydeman, J. Trapp, J. Wheeler, and K. Wohl. 2002. Waterbird Conservation for the Americas: The North American Waterbird Conservation Plan, Version 1. Waterbird Conservation for the Americas. Washington, DC. Online version available at: http://www.waterbirdconservation.org/pdfs/plan_files/complete.pdf; accessed January 2012.

¹¹ Atlantic Coast Joint Venture. February 2007. North American Waterfowl Management Plan: Continental Progress Assessment. Population Trend Data = I - Increasing; D - Decreasing; NT - No Trend.

Appendix D. Known Vegetation of John Heinz NWR

Known vegetation data is compiled from meander surveys conducted throughout John Heinz NWR in summer and fall of 2005. It is not intended as an exhaustive list or survey of the refuge, but provided for informational purposes.

Species identified as “invasive” are those listed as such by Pennsylvania Department of Conservation and Natural Resources. Additional species listed as “nonnative” may be ecologically aggressive and may require management.

Scientific Name	Common Name	Native/Nonnative/Invasive
<i>Acer negundo</i>	boxelder	Native
<i>Acer platanoides</i>	Norway maple	Invasive
<i>Acer rubrum</i>	red maple	Native
<i>Acer rubrum</i>	red maple	Native
<i>Acer saccharinum</i>	silver maple	Native
<i>Acer saccharinum</i>	silver maple	Native
<i>Aesclepius syriaca</i>	common milkweed	Native
<i>Aesclepius incarnata</i>	swamp milkweed	Native
<i>Ailanthus altissima</i>	tree-of-heaven	Invasive
<i>Alliaria petiolata</i>	garlic mustard	Invasive
<i>Ambrosia artemisiifolia</i>	common ragweed	Native
<i>Amorpha frutescens</i>	wild false indigo	Native
<i>Ampelopsis brevipedunculata</i>	porcelainberry	Invasive
<i>Andropogon gerardii</i>	big bluestem	Native
<i>Andropogon virginicus</i>	broomsedge	Native
<i>Apocynum cannabinum</i>	dogbane	Native
<i>Artemisia vulgaris</i>	mugwort	Nonnative
<i>Aster divaricatus</i>	white wood aster	Native
<i>Aster novae-angliae</i>	New England aster	Native
<i>Baccharis halmifolia</i>	groundsel-tree	Native
<i>Bidens laevis</i>	tickseed sunflower	Native
<i>Boehmeria cylindrica</i>	false nettle	Native
<i>Calamagrostis canadensis</i>	bottlebrush grass	Native
<i>Carex stricta</i>	tussock sedge	Native
<i>Carex. spp.</i>	unidentified sedge species	Native
<i>Celtis occidentalis</i>	hackberry	Native
<i>Cephalanthus occidentalis</i>	buttonbush	Native
<i>Celastrus orbiculatus</i>	Oriental bittersweet	Invasive
<i>Cirsium vulgare</i>	bull thistle	Invasive
<i>Clematis spp.</i>	unidentified clematis species	Unknown
<i>Commelina communis</i>	Asiatic dayflower	Nonnative
<i>Conyza canadensis</i>	horseweed	Native
<i>Cornus amomum</i>	silky dogwood	Native

Scientific Name	Common Name	Native/Nonnative/Invasive
<i>Crataegus</i> spp.	hawthorn	Native
<i>Dactylis glomerata</i>	orchardgrass	Nonnative
<i>Daucus carota</i>	Queen Anne's lace	Nonnative
<i>Digitaria sanguinalis</i>	crabgrass	Nonnative
<i>Echinacea purpurea</i>	purple coneflower	Native
<i>Elymus riparius</i>	riparian rye	Native
<i>Elymus virginicus</i>	Virginia wild rye	Native
<i>Erigeron</i> spp.	daisy fleabane	Native
<i>Eupatorium rugosum</i>	white snakeroot	Native
<i>Gleditsia triacanthus</i>	honey locust	Native
<i>Helianthus giganteus</i>	swamp sunflower	Native
<i>Heteranthera</i> spp.	unidentified mud-plantain	Native
<i>Hibiscus moscheutos</i>	hibiscus	Native
<i>Humulus japonica</i>	Japanese hops	Invasive
<i>Ilex verticillata</i>	winterberry	Native
<i>Iris versicolor</i>	blue flag iris	Native
<i>Juglans nigra</i>	black walnut	Native
<i>Juncus effusus</i>	dark green bulrush	Native
<i>Juncus tenuis</i>	path rush	Native
<i>Lamium amplexicaule</i>	henbit	Nonnative
<i>Ligustrum vulgare</i>	Chinese privet	Invasive
<i>Lindera benzoin</i>	spicebush	Native
<i>Liquidambar styraciflua</i>	sweetgum	Native
<i>Liriodendron tulipifera</i>	tulip poplar	Native
<i>Lonicera maackii</i> or <i>tatarica</i>	shrub honeysuckle	Invasive
<i>Lonicera japonica</i>	Japanese honeysuckle	Invasive
<i>Ludwigia palustris</i>	marsh-purslane	Native
<i>Lythrum salicaria</i>	purple loosestrife	Invasive
<i>Malus</i> spp.	unidentified crabapple species	Unknown
<i>Microstegium vinemeum</i>	Japanese stiltgrass	Invasive
<i>Monarda fistulosum</i>	wild bergamot	Native
<i>Morus alba</i>	white mulberry	Nonnative
<i>Morus papyrifera</i>	paper mulberry	Nonnative
<i>Nuphar lutea</i>	spadardock	Native
<i>Nyssa sylvatica</i>	blackgum	Native
<i>Onoclea sensibilis</i>	sensitive fern	Native
<i>Panicum virgatum</i>	switchgrass	Native
<i>Parthenosis quinquefolia</i>	Virginia creeper	Native
<i>Paulownia tomentosa</i>	Paulownia tree	Nonnative
<i>Phytolacca americana</i>	pokeweed	Native
<i>Pinus strobus</i>	eastern white pine	Native
<i>Platanus occidentalis</i>	American sycamore	Native

Scientific Name	Common Name	Native/Nonnative/Invasive
<i>Pluchea odorata</i>	marsh fleabane	Native
<i>Polygonum cespitosum</i>	long-bristled smartweed	Native
<i>Polygonum cuspidatum</i>	Japanese knotweed	Invasive
<i>Polygonum lapthifolium</i>	white smartweed	Native
<i>Polygonum perfoliatum</i>	mile-a-minute vine	Invasive
<i>Polygonum sagittatum</i>	arrow-leaved tearthumb	Native
<i>Pontederia cordata</i>	pickerelweed	Native
<i>Populus canescans</i>	gray poplar	Nonnative
<i>Populus deltoides</i>	eastern cottonwood	Native
<i>Populus grandidentata</i>	big-toothed aspen	Native
<i>Prunus serotina</i>	black cherry	Native
<i>Quercus alba</i>	white oak	Native
<i>Quercus palustris</i>	pin oak	Native
<i>Quercus phellos</i>	willow oak	Native
<i>Rhus glabra</i>	smooth sumac	Native
<i>Robinia pseudoacacia</i>	black locust	Native
<i>Rosa multiflora</i>	multiflora rose	Invasive
<i>Rubus allegheniensis</i>	blackberry	Native
<i>Rubus occidentalis</i>	raspberry	Native
<i>Rubus phoenicolasius</i>	wineberry	Nonnative
<i>Rudbeckia triloba</i>	gray-headed coneflower	Native
<i>Salix fragilis</i>	crack willow	Nonnative
<i>Salix nigra</i>	black willow	Native
<i>Sambucus canadensis</i>	elderberry	Native
<i>Sassafras albidum</i>	sassafras	Native
<i>Scirpus cyperinus</i>	woolgrass	Native
<i>Setaria spp.</i>	unidentified foxtail species	Nonnative
<i>Solidago spp.</i>	unidentified goldenrod species	Native
<i>Sonchus oleraceus</i>	sow thistle	Nonnative
<i>Sorghastrum nutans</i>	Indiangrass	Native
<i>Toxicodendron radicans</i>	Poison ivy	Native
<i>Typha angustifolia</i>	narrow leaved cattail	Native
<i>Typha latifolia</i>	broad leaved cattail	Native
<i>Ulmus americana</i>	American elm	Native
<i>Urtica dioica</i>	common nettle	Native
<i>Viburnum dentatum</i>	arrowwood viburnum	Native
<i>Vicia spp.</i>	crown vetch	Nonnative
<i>Vinca minor</i>	periwinkle	Nonnative
<i>Vitis spp.</i>	unidentified grape species	Native
<i>Wisteria floribunda</i>	Chinese wisteria	Nonnative
<i>Zizania aquatica</i>	wildrice	Native

Composition of Species	Number	Percent
Native	82	67
Nonnative	17	14
Invasive	15	12

Appendix E. Nonbird Animal Species of John Heinz NWR

Species included in this list are those observed onsite by refuge staff and volunteers as well as additional species found commonly throughout Philadelphia County according to the Pennsylvania Natural Heritage Program.

Scientific Name	Common Name
Fishs	
<i>Ameirus catus</i>	white catfish
<i>Ameirus nebulosus</i>	brown bullhead
<i>Amia calva</i>	bowfin
<i>Catostomus commersoni</i>	white sucker
<i>Channa argus</i>	northern snakehead
<i>Cyprinus carpio</i>	common carp
<i>Etheostoma olmstedii</i>	tessellated darter
<i>Gambusia affinis</i>	eastern mosquitofish
<i>Hybognathus regius</i>	eastern silvery minnow
<i>Ictalurus punctatus</i>	channel catfish
<i>Lepomis cyanellus</i>	green sunfish
<i>Lepomis gibbosus</i>	pumpkinseed
<i>Lepomis macrochirus</i>	bluegill
<i>Micropterus salmoides</i>	largemouth bass
<i>Notemigonus crysoleucas</i>	golden shiner
<i>Notropis hudsonius</i>	spottail shiner
<i>Perca flavescens</i>	yellow perch
<i>Pimephales notatus</i>	bluntnose minnow
<i>Poxomis nigromaculatus</i>	black crappie
<i>Umbra pygmaea</i>	eastern mudminnow
<i>Brevoortia tyrannus</i>	atlantic menhaden
<i>Fundulus diaphanus</i>	banded killifish
<i>Fundulus heteroclitus</i>	mummichog
<i>Leiostomus xanthurus</i>	spot
<i>Menedia beryllina</i>	inland silversides
<i>Micropogonias undulatus</i>	Atlantic croaker
<i>Trinectes maculatus</i>	hogchoker
<i>Alosa aestivalis</i>	blueback herring
<i>Alosa mediocris</i>	hickory shad
<i>Alosa pseudoherangus</i>	alewife
<i>Dorosoma cepedianum</i>	gizzard shad
<i>Morone saxatilis</i>	striped bass
<i>Morone americana</i>	white perch
<i>Mugil cephalus</i>	striped mullet

Scientific Name	Common Name
<i>Anguilla rostrata</i>	American eel
Reptiles	
<i>Thamnophis sirtalis</i>	eastern garter snake
<i>Chrysemys picta</i>	painted turtle
<i>Chelydra serpentina</i>	snapping turtle
<i>Sternotherus odoratus</i>	stinkpot turtle
<i>Pseudemys rubriventris</i>	eastern redbelly turtle
<i>Trachemys scripta elegans</i>	red-eared slider
<i>Kinosternon subrubrum</i>	eastern mud turtle
<i>Terrapene c. carolina</i>	eastern box turtle
<i>Malaclemys t. terrapin</i>	northern diamond-backed terrapin
<i>Storeria dekayi dekayi</i>	northern brown snake
<i>Nerodia sipedon</i>	northern water snake
Amphibians	
<i>Lithobates catesbeianus</i>	bullfrog
<i>Lithobates clamitans</i>	green frog
<i>Plethodon cinereus</i>	red-backed salamander
<i>Anaxyrus americanus</i>	American toad
<i>Pseudacris crucifer</i>	spring peeper
<i>Anaxyrus fowleri</i>	Fowler's toad
<i>Lithobates palustris</i>	pickerel frog
<i>Lithobates sphenocephalus</i>	northern leopard frog
Mammals	
<i>Blarina brevicauda</i>	northern short-tailed shrew
<i>Castor canadensis</i>	beaver
<i>Cryptotis parva</i>	least shrew
<i>Didelphis virginiana</i>	opossum
<i>Lontra canadensis</i>	northern river otter
<i>Marmota monax</i>	Woodchuck or groundhog
<i>Mephitis mephitis</i>	skunk
<i>Microtus pennsylvanicus</i>	meadow vole
<i>Mus musculus</i>	house mouse
<i>Mustela frenata</i>	long-tailed weasel
<i>Odocoileus virginianus</i>	white-tailed deer
<i>Ondatra zibethicus</i>	muskrat
<i>Peromyscus leucopus</i>	white-footed mouse
<i>Procyon lotor</i>	raccoon
<i>Rattus norvegicus</i>	Norway rat
<i>Sciurus carolinensis</i>	gray squirrel
<i>Sylvilagus floridanus</i>	eastern cottontail
<i>Tamias striatus</i>	eastern chipmunk
<i>Vulpes vulpes</i>	red fox

Appendix D

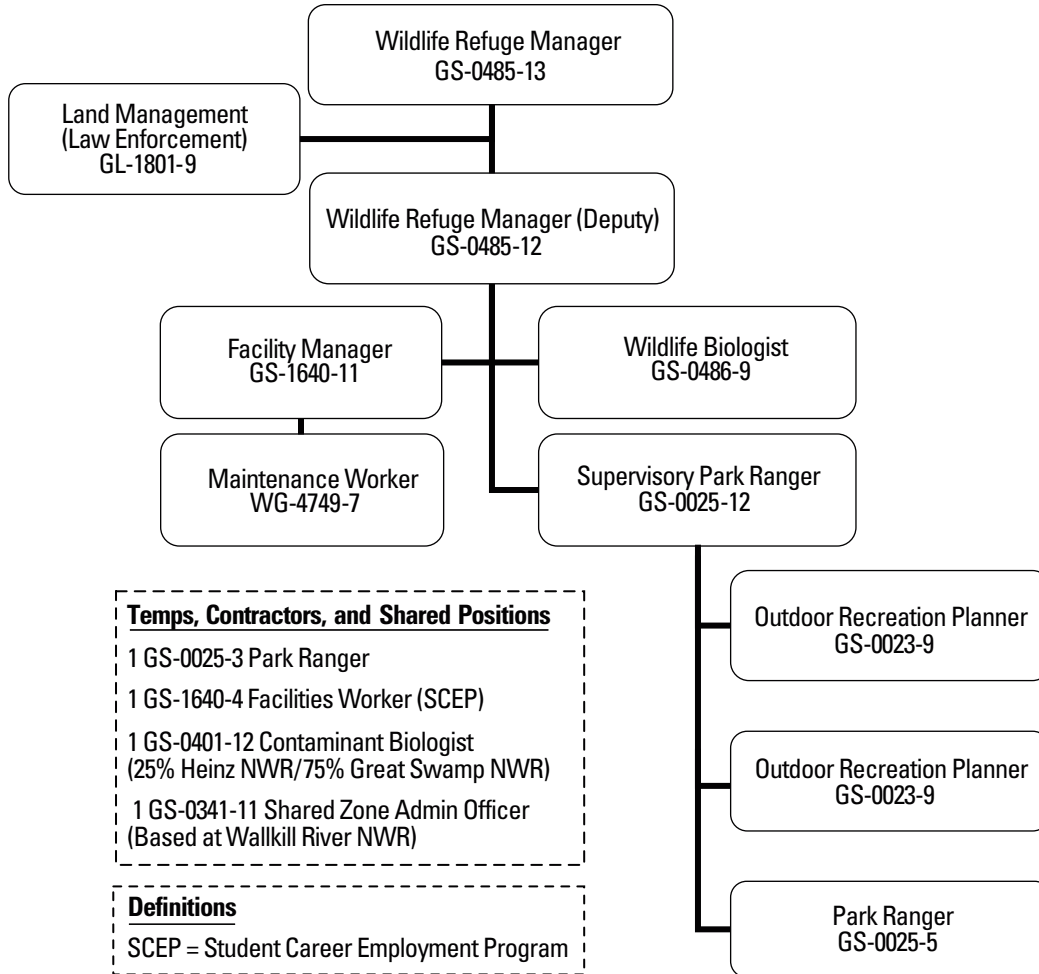


USFWS

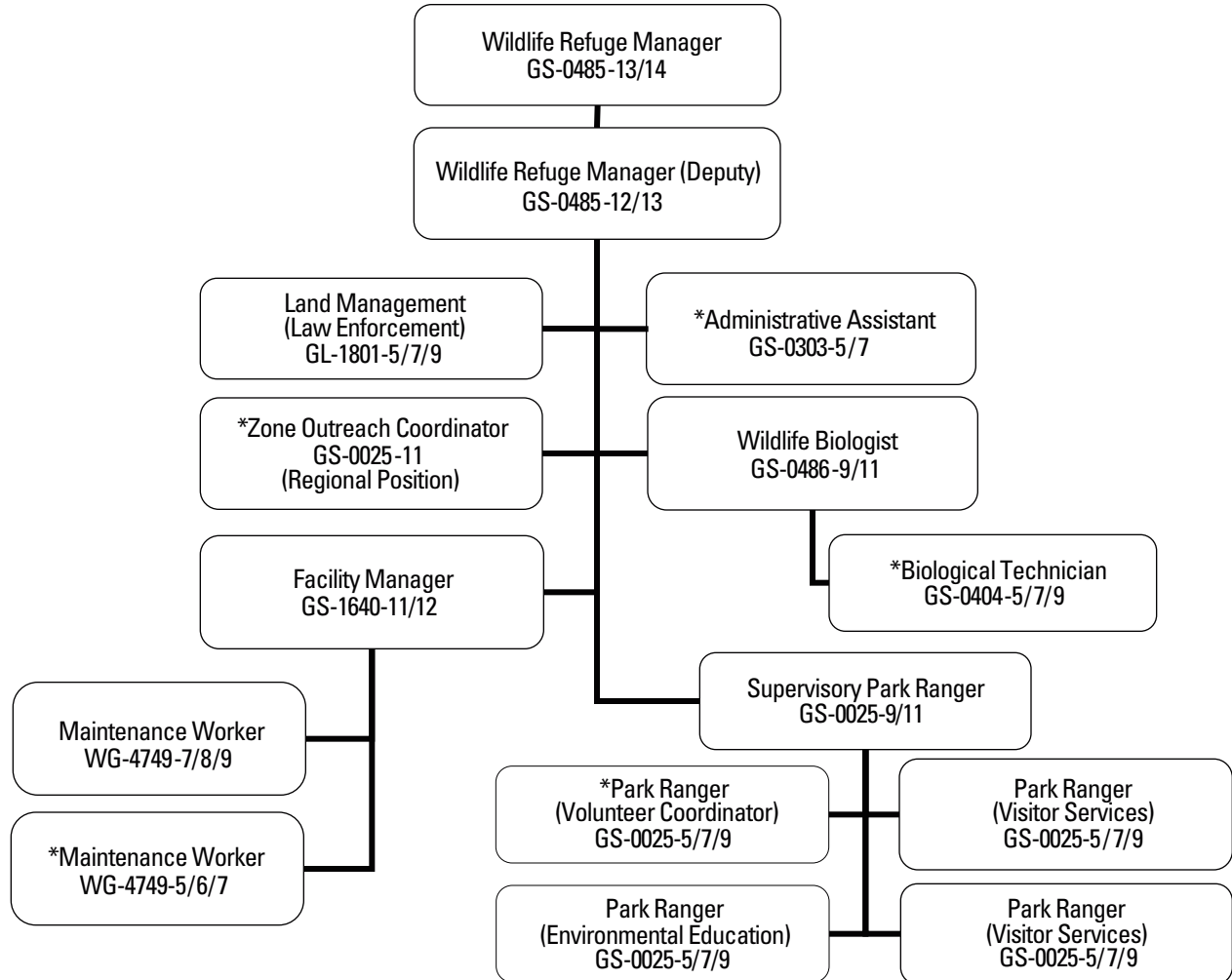
Staff photo

Refuge Staffing Charts

Current Staffing



Proposed Staffing



Temps, Contractors, and Shared Positions

- 1 GS-0025-5 Park Ranger (STEP)
- 1 GS-0404-5 Biological Technician (STEP)
- 1 GS-0401-12 Contaminant Biologist
(25% Heinz NWR/75% Great Swamp NWR)
- 1 GS-0341-11 Shared Zone Admin Officer
(Based at Wallkill River NWR)

Definitions

- * = new position
- STEP= Student Temporary Employment Program

Appendix E

Larry Woodward/USFWS



Marsh restoration project construction

Refuge Operating Needs System (RONS) and Service Asset Maintenance Management System (SAMMS)

Budget and Refuge Operations Needs System (RONS) Projects for John Heinz National Wildlife Refuge at Tinicum

<u>Staffing Model Positions-Non LE</u>			<u>Staffing Model Positions-LE</u>		
Predicted	Currently Authorized	New	Predicted	Currently Authorized	New
14	9	5	2	1	1

<u>RONS Project Positions-Non LE</u>		<u>RONS Project Positions-LE</u>	
Number	Cost	Number	Cost
5	\$524,189	1	\$150,000

Table E.1. Refuge Operations and Needs System (RONS) table.

Project Type	Project #	Project Title	Complete	Station Rank	One-Time	Recurring Cost	Total First Year Need
Project	FY08-4184	Park Ranger-Outreach/Education/Resource Management	Yes	1		\$104,267	\$104,267
Project	FY08-4154	Staff Education Center and Improve administrative efficiencies	Yes	2		\$85,243	\$85,243
Project	FY08-3634	Remove and control 112 acres of invasive species	Yes	3	\$80,000	\$5,000	\$132,357
Project	FY08-3678	Conduct long term monitoring and management of deer herd	Yes	5	\$45,000	\$15,000	\$98,231
Project	FY-08-4171	Provide Metro Educational Programs and Public Outreach	Yes	6		\$126,146	\$126,146
Project	FY08-4168	Increase capacity of refuge volunteer program	Yes	7		\$104,267	\$104,267
Project	FY08-4166	Increase capacity of refuge volunteer and visitor program	Yes	8		\$104,267	\$104,267
Project	FY08-3666	Create/maintain habitat for endangered leopard frog	Yes	9	\$40,000	\$20,000	\$96,231
Project	FY10-1446	Provide Visitor, Resource, and Facility Protection (Law Enforcement)	Yes	10		\$150,000	\$150,000
Project	FY10-2445	Address Superfund and other refuge contaminant issues	Yes	12		\$15,000	\$99,000
Draft	FY10-2332	Superfund Contaminants Biologist	Yes	13		\$151,200	\$151,200

Service Asset Maintenance Management Systems (SAMMS) Projects for John Heinz National Wildlife Refuge at Tinicum

Table E.2. Service Asset Maintenance Management Systems (SAMMS) table.

Work Order #	Description	Estimated Costs	Additional Comments
04133625	Replace water control structure	\$363,000.00	
04133628	repair asphalt roads and parking lot @ maintenance compound	\$85,000.00	
2005256644	Rehab Cross-Dike slope	\$88,000.00	
2005256667	Replace trail kiosk and blinds	\$37,500.00	
2005256677	Rehab Trolley Bed Dike and Dike Road	none	
2006422797	Rehab CEEC exhibit wing flooring	none	
2006506784	Construct low impact boardwalk / trail	\$71,200.00	Project note: 5/29/09 \$209,000.00 to \$200,000.00 reduce allocation requested in FY 2012
2006506791	Construct 30 acres of filled tidal marsh	none	
2007716434	Rehab storage bldg. by replacing doors, windows, gutters	\$10,744.40	
2007726677	Replace SR 420 fishing pier	none	
2007731479	Construct visitor information kiosk @ both sides of SR 420	none	
2007732327	Construct interpretive sign panels	none	
2007732861	Construct accessible trail connection & fishing pier	none	
2008867335	Deteriorated 16 Acre Pond parking lot	none	
2009917687	Construct energy efficient housing	\$1,303,000.00	
2009942946	Construct pavillion at visitor facility	\$100,000.00	
2009945308	Rehab CEEC exhibit wing electrical system, plan year 2013	\$303,900.00	Approval date 9/28/09
2009956544	Environmental Ed. Center 20 KW solar PV system, plan year 2011	\$225,000.00	
2010121803	Rehab CEEC leaking metal roof	\$125,000.00	
91104568	Rehab Trolley Bed Dike slope	\$51,000.00	
93104560	Rehab Cross Dike slope	\$88,000.00	
98104566	Replace Trail kiosks and blinds, plan year 2015	\$37,500.00	

Appendix F

Larry Woodward/USFWS



Philadelphia skyline visible over Darby Creek and Tinicum marsh

Wilderness Review

- **F.1 Introduction**
- **F.2 Minimum Wilderness Criteria**
- **F.3 Inventory Conclusions**
- **F.4 Service Summary and Conclusion of Wilderness Inventory Findings**

F.1 Introduction

The purpose of a wilderness review is to identify and recommend to Congress lands and waters of the National Wildlife Refuge System (Refuge System) that merit inclusion in the National Wilderness Preservation System (NWPS). Wilderness reviews are required elements of comprehensive conservation plans, are conducted in accordance with the refuge planning process outlined in the Fish and Wildlife Service Manual (602 FW 1 and 3), and include compliance with the National Environmental Policy Act (NEPA) and public involvement.

The wilderness review process has three phases: (I) inventory, (II) study, and (III) recommendation. In the inventory phase, we create wilderness inventory areas (WIAs) after mapping all Service fee-owned lands and waters on the refuge. Any WIAs meeting the minimum criteria for a federally designated wilderness are identified as wilderness study areas (WSAs).

The purposes of the wilderness inventory phase are to:

- Identify Refuge System lands and waters with wilderness character and establish those areas as WSAs.
- Identify areas of Refuge System lands and waters that do not qualify as WSAs.
- Document the inventory findings for the planning record.

F.2 Minimum Wilderness Criteria

A WSA is required to be a roadless area or an island of any size, meet the size criteria, appear natural, and provide for solitude or primitive recreation.

Size — The size criteria can be satisfied if an area has at least 5,000 acres of contiguous roadless public land, or is sufficiently large that its preservation and use in an unimpaired condition is practicable.

Roadless — Roadless refers to the absence of improved roads suitable and maintained for public travel by means of motorized vehicles primarily intended for highway use. A route maintained solely by the passage of vehicles does not constitute a road. Only Federal lands are eligible to be considered for wilderness designation and inclusion within the NWPS.

Naturalness — The Wilderness Act, Section 2(c), defines wilderness as an area that “generally appears to have been affected primarily by the forces of nature with the imprint of human work substantially unnoticeable.” The area must appear natural to the average visitor, rather than “pristine.” The presence of historic landscape conditions is not required.

Solitude or Primitive and Unconfined Recreation — A WSA must provide outstanding opportunities for solitude or primitive and unconfined recreation. The area does not have to possess outstanding opportunities for both solitude and primitive and unconfined recreation, and does not need to have outstanding opportunities on every acre. Further, an area does not have to be open to public use and access to qualify under this criterion. Opportunities for solitude refer to the ability of a visitor to be alone and secluded from other visitors in the area. Primitive and unconfined recreation means nonmotorized, dispersed outdoor recreation activities that are compatible and do not require developed facilities or mechanical transport.

Supplemental Values — The Wilderness Act states that an area of wilderness may contain ecological, geological, or other features of scientific, educational, scenic or historical value. Supplemental values of the area are optional, but the degree to which their presence enhances the area’s suitability for wilderness designation should be considered. The evaluation should be based on an assessment of the estimated abundance or importance of each of the features.

F.3 Inventory Conclusions

Evaluating Roadless Criteria

The John Heinz National Wildlife Refuge (John Heinz NWR, refuge) does not meet the roadless criteria. Refuge lands are bounded or divided by roads. A major highway, Interstate 95, runs east-west across the southern refuge boundary. The refuge is also includes several service roads.

Evaluating Size Criteria

The total approved acquisition boundary for the refuge is 1,200 acres, thus it cannot include any roadless areas of at least 5,000 acres. Due to the presence of access roads, adjacent roads, and remnants of historic disturbance (dikes, fences, and former water control structures), there is no smaller acreage of sufficient size to preserve and use in an unimpaired condition. Furthermore, no lands within the refuge are contiguous to other agency-owned lands under review for wilderness areas.

Evaluating Naturalness Criteria

The refuge does not satisfy the naturalness criteria, as the area has been highly modified for human use with the arrival of European settlers. Prominent features of human origin are the remnants of a trolley railbed, dikes around the impoundment, presence of a landfill, a managed impoundment, and other remnants of older infrastructure. Currently, over 2 miles of dikes and at least three water control structures are found on the refuge.

In addition to water control structures and dikes, refuge infrastructure includes buildings and roadways that require regular maintenance. There are also a wildlife observation tower, trails, signs, parking areas, viewing blinds, and boundaries that are maintained. Facilities currently include the refuge headquarters and visitor center, as well as two maintenance buildings.

In addition to the roads described in the “Evaluating Roadless Criteria” section, two railroads pass along the southeastern boundary of the refuge. Furthermore, gas and oil pipelines transect or run adjacent to refuge lands. Several telephone, gas, oil, and other utilities also run adjacent or through the refuge.

Evaluating Solitude or Primitive and Unconfined Recreation Criteria

The refuge does not meet criteria for solitude and primitive/unconfined recreation criteria. The number of annual visits to the refuge is currently estimated at almost 135,000 and is expected to increase over the next 15 years. The refuge consists primarily of inaccessible/off-limit wetlands with relatively few upland areas, and visitor use is concentrated on dike roads, and upland trails. Consequently, even during times of the year when visitation is typically at its lowest, one is likely to see other people on the refuge, regardless of location. Waterways and other areas that can be accessed by boat consist of canals or flooded impoundments, neither of which are sufficiently large to allow visitors to experience solitude.

F.4 Service Summary and Conclusion of Wilderness Inventory Findings

We utilized the refuge in its entirety, as owned by the Service in fee title, within the approved acquisition boundary as the basis for our WIA. We then evaluated the refuge to determine if it met the minimum criteria for wilderness as identified in Section 2(c) of the Wilderness Act.

Based on our review, the 1,193-acre John Heinz NWR does not meet the size criteria for a WSA. It is less than 5,000 acres and its size is not sufficient to preserve natural ecological processes unique to a wilderness setting. Chapter 2 maps show the current refuge-owned lands, easements and proposed acquisition boundaries. We will reevaluate this determination in 15 years with the revision of this CCP, or sooner if significant new information warrants a reevaluation. In summary, at this time additional study is not warranted.

Appendix G

Dan Salas/Cardno JFNew



Darby Creek

Wild and Scenic Rivers Review

- G.1 Introduction
- G.2 Wild and Scenic River Review
- G.3 Summary and Conclusion of Wild and Scenic Rivers Review

G.1 Introduction

The Wild and Scenic Rivers Act, (Public Law 90-543 as amended: 16 U.S.C. 1271-1287) (Act) establishes a method for evaluating and providing Federal protection for certain free-flowing rivers, preserving them and their immediate environments for the use and enjoyment of present and future generations. One outcome of that Act is a national system of designated wild, scenic, or recreational rivers included in the National Wild and Scenic River System. Section 5(d) (1) of the Act states in part: In all planning for the use and development of water and related land resources, consideration shall be given by all Federal agencies involved to potential national wild, scenic, and recreational river areas, and all river basin and project plan reports submitted to the Congress shall consider and discuss any such potential.

G.2 Wild and Scenic River Review

The purpose of this wild and scenic river review is to inventory and study the rivers, river segments and their immediate environments within the refuge planning area to determine if they merit inclusion in the National Wild and Scenic River System.

As part of the Section 5(d) (1) review process, we are required to include all river segments that are within the planning area and listed in the Nationwide Rivers Inventory. The Nationwide Rivers Inventory is maintained by the National Park Service and lists more than 3,400 free-flowing river segments in the United States that are believed to possess one or more “outstandingly remarkable” natural or cultural values judged to be of more than local or regional significance.

G.3 Service Summary and Conclusion of Wild and Scenic River Review

Darby Creek is the only major waterway that flows through refuge lands. We reviewed the Nationwide Rivers Inventory and found no record of Darby Creek within its listing. As a result, the portion of Darby Creek within John Heinz National Wildlife Refuge at Tinicum is not considered by the Nationwide Rivers Inventory as having outstanding remarkable values or potential for special designation. Despite its habitat and recreation values to the refuge, Darby Creek is not eligible for a wild and scenic designation.

Appendix H

Katherine Whittmore/USFWS



Students enjoying the open water and marsh habitats of the refuge

USGS Phase I Environmental Education Report



John Heinz National Wildlife Refuge Environmental Education Stakeholder Analysis—Phase I Report

By Marcella Wells, Diane White, and Natalie R. Sexton



Photo by Frank Doyle, U.S. Fish and Wildlife Service Volunteer

Report Series 2011–XXXX

U.S. Department of the Interior
U.S. Geological Survey

U.S. Department of the Interior
KEN SALAZAR, Secretary

U.S. Geological Survey
Marcia K. McNutt, Director

U.S. Geological Survey, Reston, Virginia 2011

For product and ordering information:
World Wide Web: <http://www.usgs.gov/pubprod>
Telephone: 1-888-ASK-USGS

For more information on the USGS—the Federal source for science about the Earth,
its natural and living resources, natural hazards, and the environment:
World Wide Web: <http://www.usgs.gov>
Telephone: 1-888-ASK-USGS

Suggested citation:
Wells, Marcella, White, Diane, and Sexton, N.R., 2011, John Heinz National Wildlife Refuge
environmental education stakeholder analysis—Phase I report: U.S. Geological Survey Administrative
Report 2011-XXXX, 41 p.

Any use of trade, product, or firm names is for descriptive purposes only and does not imply
endorsement by the U.S. Government.

Although this report is in the public domain, permission must be secured from the individual
copyright owners to reproduce any copyrighted material contained within this report.

Contents

Introduction.....	H-5
Purpose of this Project	H-5
Definitions.....	H-5
Context	H-6
Geographic Context.....	H-6
Planning Context	H-9
Staffing.....	H-10
Procedure.....	H-10
Findings.....	H-11
Refuge Audiences and Visitors.....	H-11
John Heinz National Wildlife Refuge Current Approach to Environmental Education	H-12
Programs and Partnerships	H-13
Refuge Partnerships	H-19
Outreach Materials	H-22
Discussion	H-23
Gaining an Internal Perspective.....	H-23
Gaining an External Perspective	H-25
Next Step: Phase II Stakeholder Interviews	H-26
Appendix A.....	H-28
Summary of Recommendations from Visitor Services Review by Ten Visitor Services Criteria	H-28
Appendix B.....	H-32
Original Data Worksheets.....	H-32
Appendix C.....	H-58
Documents and Sources Reviewed for this Project.....	H-58

Figures

Figure H.1. Map of John Heinz National Wildlife Refuge.	H-7
Figure H.2. John Heinz National Wildlife Refuge in reference to Philadelphia as the center of the Pennsylvania Greater Metropolitan Area.	H-8
Figure H.3. Planning Context for Stakeholder Assessment Project.	H-9
Figure H.4. Current John Heinz National Wildlife Refuge Staffing.	H-10

Tables

Table H.1. Delaware Valley Counties.....	H-6
Table H.2. Annual Number of Visitors to the John Heinz National Wildlife Refuge.....	H-12
Table H.3. Annual Visitation by Other Types of Effort at the John Heinz National Wildlife Refuge.....	H-12
Table H.4. Refuge Programming.....	H-13
Table H.5. Onsite Events and Festivals.....	H-14
Table H.6. Onsite Programs–Facilitated Learning Experiences.....	H-15
Table H.7. Onsite Training for Teachers and Pre-service Teachers.....	H-17
Table H.8. Onsite Research.....	H-18
Table H.9. Onsite Meetings and Retreats.....	H-18
Table H.10. Offsite Events or Festivals in which John Heinz National Wildlife Refuge Participates.....	H-18
Table H.11. Offsite Presentations or Programs Presented by John Heinz National Wildlife Refuge Staff..	H-18
Table H.12. Potential Environmental Education Partners for John Heinz National Wildlife Refuge	H-20
Table H.13. Summary of Select Refuge Outreach Printed Material.....	H-22

John Heinz National Wildlife Refuge Environmental Education Stakeholder Analysis—Phase I Report

By Marcella Wells,¹ Diane White,¹ and Natalie R. Sexton²

Introduction

The John Heinz National Wildlife Refuge (John Heinz Refuge, refuge) is located in Philadelphia and Delaware Counties, Pennsylvania, and has so far acquired 997 acres of 1,200 authorized by Congress. The purpose of the refuge is to:

- protect, preserve, and restore wildlife and habitat in the natural area known as Tinicum Marsh;
- create an Environmental Education Center and provide for compatible wildlife-oriented recreation opportunities; and
- develop, advance, manage, conserve, and protect fish and wildlife resources.

Recently, the refuge initiated a Comprehensive Conservation Planning (CCP) effort to help guide the management of the refuge over the next 15 years. As part of that planning process, a Visitor Services Review was conducted in August 2009, by refuge managers and visitor service specialists external to this refuge. Concurrently, and as part of the public involvement requirement for the CCP effort, this stakeholder assessment, related specifically to environmental education, was commissioned. This status report provides the findings of Phase I of the two phase project. Discussion of findings from Phase I, contained in this report, will serve to guide the second phase of the project.

Purpose of this Project

This Environmental Education Stakeholder Assessment (EESA) is a collaboration between the consultants at Wells Resources, Inc., the Refuge Manager Gary Stolz and staff, and the U.S. Geological Survey's (USGS) Policy Analysis and Science Assistance (PASA) Branch.

The current purpose of the project is to:

- define and refine the environmental education niche for the refuge,
- help prioritize goals for environmental education that might be included in the CCP process and future planning, and
- propose methods for maximizing the use of the refuge facilities for environmental education and interpretation.

Definitions

Throughout this project and report, two terms are used: stakeholder and partner or potential partner. *Stakeholder* is a broader term encompassing any individual or group having a vested interest in the refuge, its planning, or management (for example, visitors, special interest groups, user groups,

¹ Wells Resources, Inc., Fort Collins, CO 80524

² US Geological Survey Fort Collins Science Center, Fort Collins, CO 80526

and so forth). A *partner* or *potential partner*, in the context of this project and report refers to those entities who have (or could have) an interest in the refuge in terms of environmental education or interpretation (as defined by the U.S. Fish and Wildlife Service as priority public uses), but with an emphasis on curriculum-based environmental education. Partners or potential partners are categorized by providers and consumers (further discussed in this report).

Context

Geographic Context

The boundaries of John Heinz Refuge are within Philadelphia, a city of approximately 1.5 million people, and southeastern Delaware County (fig. H.1). The greater Delaware Valley or the Philadelphia-Camden-Wilmington Metropolitan Statistical Area (MSA) is also served by this refuge (fig. H.2). This MSA is comprised of 11 counties (table H.1) and is the fifth-largest metropolitan area in the country with a population of nearly 6 million people (2010 Census data).

Table H.1. Delaware Valley Counties.

States	Counties
Pennsylvania	Bucks, Chester, Delaware, Montgomery, and Philadelphia
Delaware	New Castle
Maryland	Cecil
New Jersey	Burlington, Camden, Gloucester, and Salem

Figure H.1. Map of John Heinz NWR.

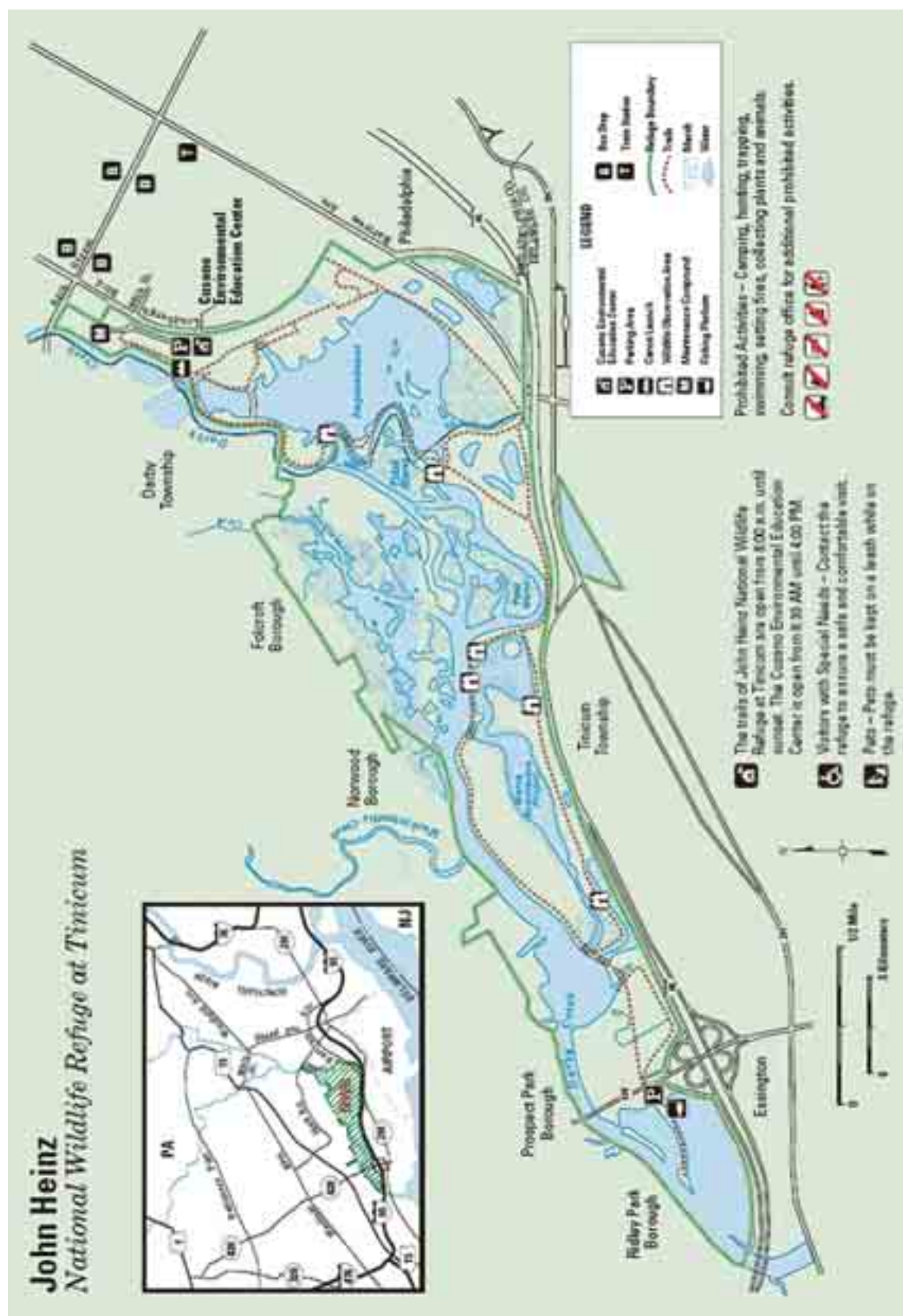
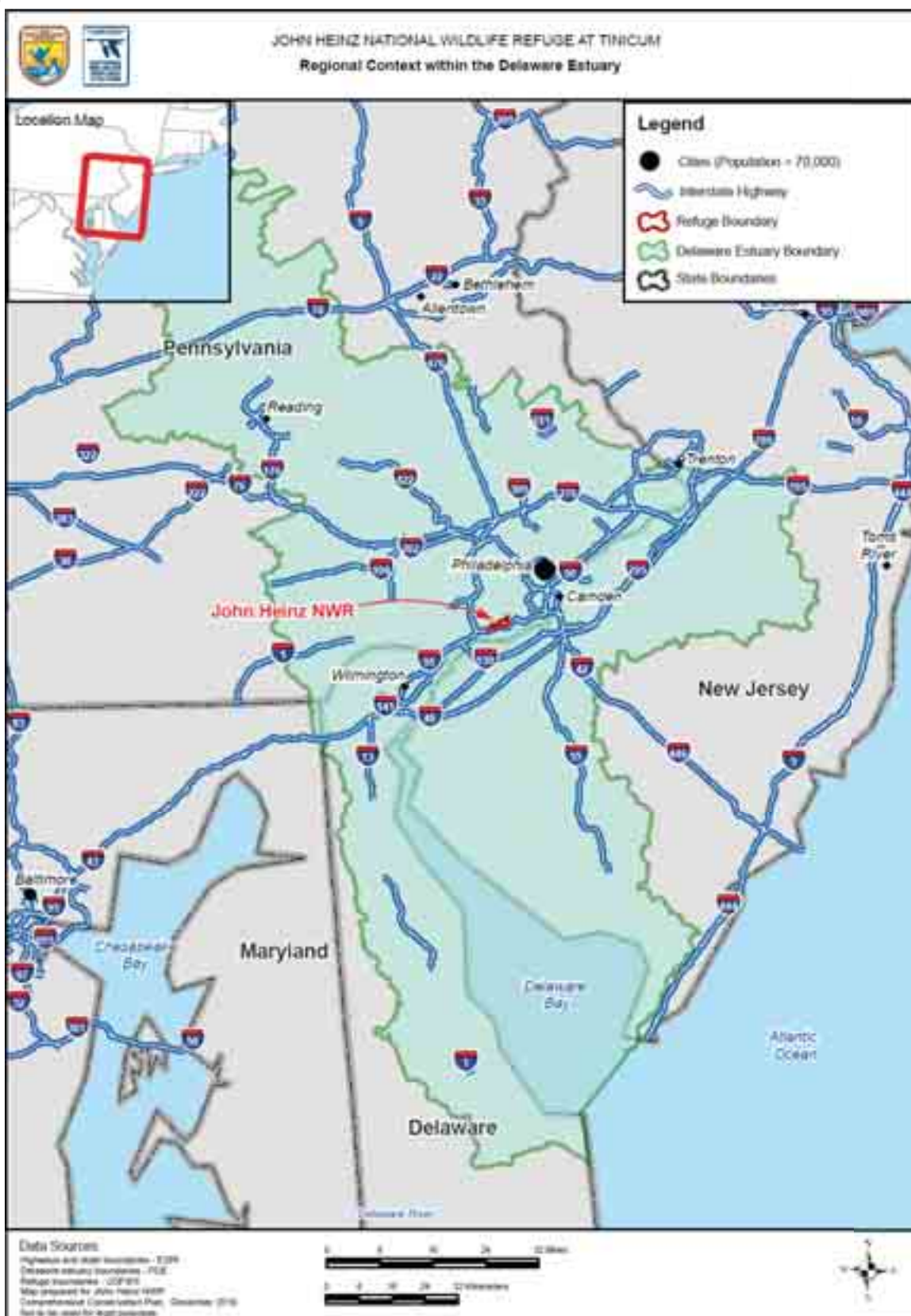


Figure H.2. John Heinz NWR in reference to Philadelphia as the center of the Pennsylvania Greater Metropolitan Area.



Planning Context

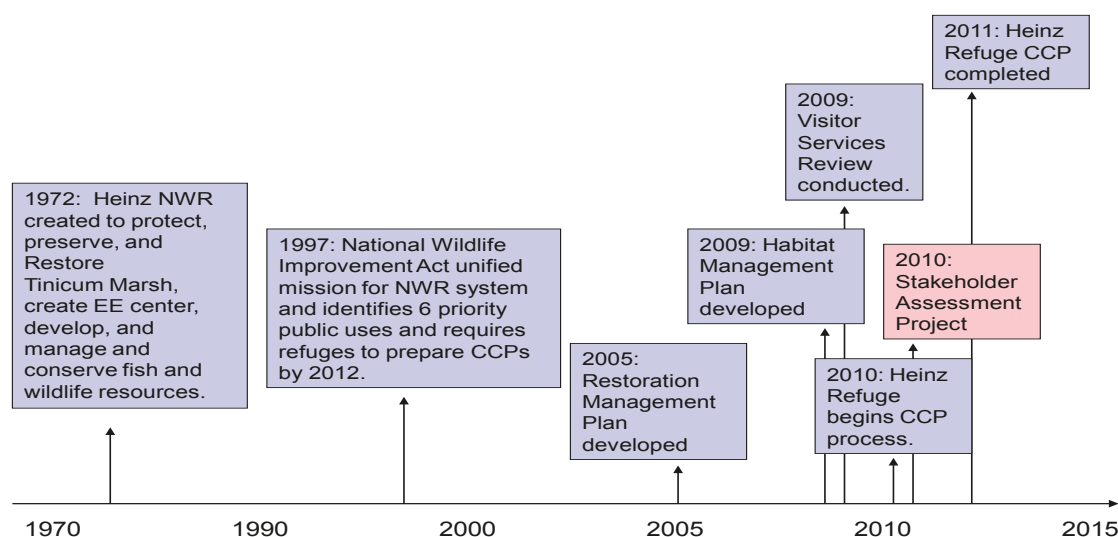
The Refuge was established in 1972 to:

- protect, preserve, and restore wildlife and habitat in the natural area known as Tinicum Marsh;
- create an Environmental Education Center for the purpose of providing education about the environment, and provide for compatible wildlife-oriented recreation opportunities; and
- develop, advance, manage, conserve, and protect fish and wildlife resources.

In 2006, as part of the Strategic Downsizing Plan for the National Wildlife Refuge System, environmental education and interpretation were identified by the U.S. Fish and Wildlife Service (the Service) Region 5 office and the refuge as the refuge's areas of emphasis.

This project is an assessment of audiences and potential stakeholders for the refuge to inform subsequent planning processes related to or associated with the Comprehensive Conservation Plan to be completed by 2011. Figure H.3 illustrates where this project fits into recent planning initiatives of the refuge.

Figure H.3. Planning Context for Stakeholder Assessment Project.



Note: Diagram limited to select refuge-specific plans only. Other regional or national plans are not included here.

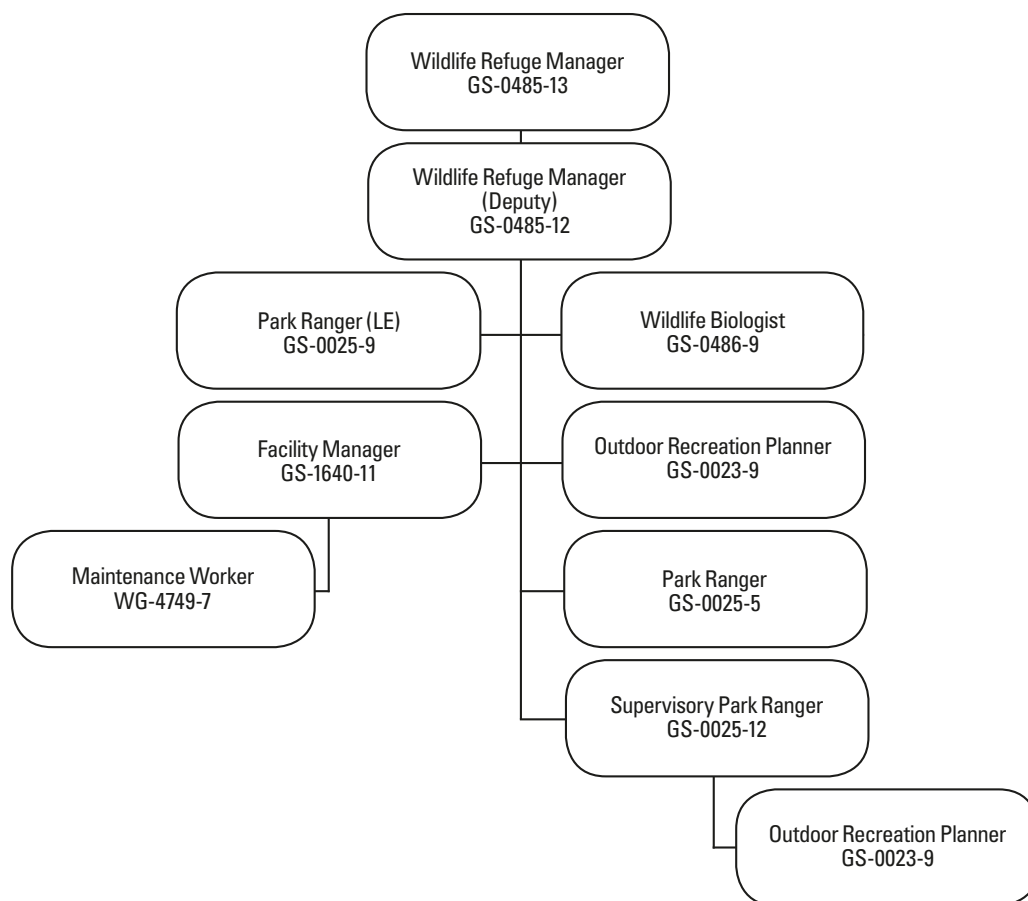
In fall 2009, a Visitor Services Review (VSR) was completed by an external review team. That document provides recommendations for each of ten visitor services criteria (see Appendix A) and suggests additional planning, which includes: finalization of the current Visitor Services Plan, an Outreach Plan, a Fishing Plan, an Environmental Education Plan, and an Interpretive Plan.

The VSR also provides an inventory of the existing conditions at the refuge. Some of the inventory and recommendations in that report overlap with issues raised in this project, so every effort is made here to complement rather than repeat the work of that external review team.

Staffing

The current staffing is represented by Figure H.4.

Figure H.4. Current John Heinz NWR Staffing.



Procedure

The first phase of this project focused on diagnostics and document review, with the intent of understanding the planning context and identifying available sources of information about visitors, programs, and stakeholders. During this phase, the project team worked with the refuge manager and staff in onsite interviews, through email, and over the phone. Two focused but informal face-to-face meetings with the refuge manager (one of which also involved some face-to-face communication with both outdoor recreation planners) were conducted during July and August. Four follow-up phone interviews were conducted, in conjunction with multiple email exchanges, to ask several program- and visitor-related questions of both the park ranger (EE) and the supervisory park ranger (EE). In addition, a number of refuge-specific documents and sources were reviewed (see Appendix C) for content relevant to this project. Findings are presented below.

Findings

This section reports preliminary findings pertaining to this stage of the project (Phase I) and contains data from document review and staff communication. An Excel file with five separate worksheets (referred to hereafter as original data worksheets) was developed after the initial site visit and an interview with the refuge manager. In the absence of any immediately available written data, these worksheets were designed by the researchers to provide a framework for the refuge manager and staff to enter as much information about audiences, visitors, partners, and stakeholders as possible. These forms were used iteratively over the next several weeks to capture information from refuge staff. At times, the researchers re-categorized and organized the data provided by staff, but the final versions of the original data worksheets were reviewed by the refuge manager and staff for accuracy, and were approved. For clarity, what is reported below is an abbreviated summary and re-categorization of that data in anticipation of future discussions and management of audience information. Original data worksheets can be found in Appendix B of this document.

Below, data about refuge audiences and visitors are presented first, followed by the refuge's approach to environmental education, and then data related to programs and partnerships. Finally, a brief summary of select marketing and educational materials is provided. A discussion of these findings and recommendations for next steps are provided in the final sections of this report.

Refuge Audiences and Visitors

The 2009 Visitor Services Review document suggests that the refuge receives approximately 125,000 visitors per year. The refuge uses a multiplier of five on the actual count of visitors to the Visitor Center to determine approximate annual usage of all facilities. Table H.2 summarizes annual refuge visitation for the years 2001 to 2010. Table H.3 provides a partial breakdown of annual visitation from 2004 to 2010 into different types of people served and programs provided related to environmental education and/or interpretation.

Table H.2. Annual Number of Visitors to the John Heinz NWR.¹

Year²	Total number of annual visitors into visitor center (counts)³	Total visitors to refuge (using multiplier)
2010	20,185 (Oct–July)	100,925 (Oct–July)
2009	26,566	132,830
2008	23,306	116,530
2007	23,819	119,095
2006	21,298	106,491
2005	20,184	100,920
2004	20,861	104,305
2003	18,460	93,200
2002	23,656	118,280
2001	21,658	108,290
Average Annual Visitation	25,847	137,285⁴

1. All data were provided by staff (see Appendix B for complete data sets).

2. Data are reported by fiscal year (Oct. –Sept. 30).

3. The refuge counts the number of people who visit the Visitor Center, then uses a multiplier of 5 to estimate the total visitors to the refuge. For 2001 to 2009, staff provided researchers with number of Total visitors to refuge. Researchers divided this number by 5 to generate the numbers used in the table for Total visitors to Visitor Center.

4. Average annual visitation was calculated from 2001–2009 annual visitation data only, since 2010 was partial year data.

Table H.3. Annual Visitation by Other Types of Effort at the John Heinz NWR.¹

Year²	Field trip visitors³	Visitors who received guided tours (by staff/volunteer)⁴	Total programs delivered (by staff/volunteers)⁵	People served offsite (by staff/volunteers)
2010	8223	1,335	30	1,165
2009	8196	13,283	30	1,800
2008	7797	2,450	25	500
2007	7087	4,765	25	500
2006	6729	2,130	20	400
2005	5823			
2004			176	24,364

1. All data, except for field trip data, were provided by staff (see Appendix B – Original Data Worksheets for complete data sets).

2. Data are reported by fiscal year. Data for 2010 are for October 2009 to July 2010 only.

3. All field trip visitors were school children participating in organized environmental education programs. Field trip visitor data is from Draft John Heinz NWR at Tinicum Environmental Education Plan 2010.

4. These numbers may include field trip visitors as well as other visitors.

5. All programs were delivered offsite, with the exception of 15 programs in 2010 for which the locations were unknown.

John Heinz National Wildlife Refuge Current Approach to Environmental Education

To understand the refuge's current approach to environmental education, several sources were consulted, including refuge staff and the Visitor Services Review. The refuge uses a "Train the Trainer" approach to environmental education with recent expansion into direct student teaching. Staff offers teacher trainings and is well-versed in delivering Project WET, WILD, and Learning Tree workshops. Pre-service and master level teachers are also a target audience through the refuge's

partnership with Widener University. The Refuge Environmental Education Development (REED) team, a group of teacher volunteers, developed a curriculum specific to the refuge that is available for teachers, as are loan boxes and other digital media. Field trips coming to the refuge are generally guided by the teacher and/or chaperones that accompany the group. Visitors coming to enjoy the refuge grounds generally visit on their own time, though weekend volunteer-led walks, talks, and programs are offered.

Programs and Partnerships

Data from the staff interviews and several iterations and verifications of the original data worksheets provide current documentation of programming at the refuge. There are many ways to look at visitor trends and refuge use. One approach is to consider onsite experiences (visitation) and offsite experiences (outreach). Table H.4 organizes the refuge's specific programming into these two major categories.

Table H.4. Refuge Programming.

Onsite experiences	Offsite experiences
Events and festivals (table H.5)	Events and festivals (table H.10)
Programs (table H.6)	Presentation and programs (table H.11)
Training (table H.7)	
Research (table H.8)	
Meetings and retreats (table H.9)	

In anticipation of further environmental education discussion and decision making, tables H.5–H.11 were created to further analyze the program and stakeholder data captured in the Original Data Worksheets. Appendix B contains full documentation of all program and partner data provided by the refuge to date. Blanks within the charts below indicate data that is unknown, was not provided, or was not requested by researchers. For example, the *Frequency* column was not a category solicited in the Original Data Worksheets, but data for this category was surmised, when possible, from the descriptions provided by staff. This category was added to these tables as it was deemed a useful category for understanding total visitor participation. The column *Proximity of audience to Refuge* was also added by the researchers. When possible, best guesses were made by the researchers for categorizing proximity based on information provided by the refuge. For the purposes of tables H.5–H.11, the following definitions were deemed useful for organizational purposes and for possible future segmentation and planning:

- **Neighbor:** less than 1 mile of refuge; walkable
- **Local:** within 1 to 5 miles from refuge; likely requires transportation
- **Area:** 6 to 20 miles from refuge; requires transportation
- **Region:** more than 20 miles from refuge; requires transportation
- **National:** out-of-state visitors
- **International:** out-of-country visitors

Table H.5. Onsite Events and Festivals.

Title and description	Organizations involved	Audiences served	Proximity of audience to Refuge	Numbers served	Frequency of events/festivals
Cradle of Birding Wildlife Conservation Festival: annual booth and program festival	varies, see Partner List in Original Data Worksheets	community and families	neighbors, locals, area and regional residents	1300	once per year in September
Federal Junior Duck Stamp Competition: annual youth art competition	Refuge	K-12 students	statewide	300–700	once per year
Art Exhibits: nature based art exhibits of regional artists	Refuge	community and families	local, regional		throughout the year
Darby Creek Clean Up: annual Refuge Earth Day clean-up	Waste Management, Friends of Refuge	community and families	neighbors, locals, area residents	~200	once per year (April – Earth Day)
International Migratory Bird Day: annual booth/program birding event	Partners in Flight, National Audubon and FWS Office of Migratory Bird Management	community and families	neighbors, locals, area residents	100	once per year
National Wildlife Refuge Week: annual booth/program festival and art show	Varies, see Partner List in Original Data Worksheets	community and families	neighbors, locals, area residents	200	once per year
Pathways to Fishing: 2 free fishing days at Refuge	PA Fish and Boat Commission	community and families	neighbors, locals, area residents	75–150	two times/year with Statewide free fishing days

Table H.6. Onsite Programs–Facilitated Learning Experiences.

Title and description	Organizations involved	Audiences served	Proximity of audience to Refuge	Numbers served	Frequency of programs
Family Nature Program: monthly 2 hr lecture/hands-on experience	Refuge	families with youth 8–14 yrs old	neighbors, locals, area residents	25–40/year	monthly
Green Building Tours: tours of VC and Marsh Machine	Refuge	University Architecture students	locals and area residents	100/year	as requested
Nature walks: birds, trees, flowers, butterflies, owls	Refuge	community members and families	neighbors, locals, area residents	~600/year	periodic: weekly and monthly, seasonal; some evenings
Story Time: monthly story time for kids	Refuge	families of 4–7 year olds	neighbors, locals, area residents	25–40/year	12/year
Through the Lens, Summer Nature Photography Program: two photography programs	Refuge (staffing), Friends of Refuge photo group (funding and mentoring)	12–18 year olds	neighbors, locals, regional	10–50/program	TTL 1/yr and Summer camp 1/yr
YMCA Fishing Camps: onsite fishing camps	YMCA	youth	area	300	10 camps of 30 youth in 2010
YMCA Conservation Camps	YMCA	youth		80	
“Bigs and Littles”: field trip to introduce kids to the Refuge	Big Brother/Big Sister Program	youth and mentors	area	881 with major BBBS event in 2010	
Scout Badges Programs: conservation activities for scout merit badges and Refuge patch	Boy/Girl Scouts	youth	neighbors, local, area, regional residents	75–100 plus 2,000–3,000 more offsite per year	
Micro-Adventures: mentoring program, collect samples, ID, use microscopes; extensions back in classroom	Interboro School District, Philly Mennonite MS and HS, NJ Middle School	middle school and high school students	local, area, regional students	350	as requested. 2010 ran 10/yr

Title and description	Organizations involved	Audiences served	Proximity of audience to Refuge	Numbers served	Frequency of programs
Spring break and summer camps: 3–4 day camps in the summer and during school breaks	Elementary Schools – Patterson, Widener, Longstreth	3rd and 4th graders	local and area youth	10–20/camp in 2010 with Refuge goal of 30/camp (classroom size)	
Summer camps	Philadelphia Academy of Natural Sciences; Natural History Museum	outside partner-run camps with overlapping conservation missions			held 6 times
Saturday Ecology Academy: mentor program for teen girls	Widener University	pre-service teachers develop curriculum and teach underserved teen girls	Chester area	20–40/year	5 Saturdays repeated with same 20 youth for depth of program
Field trips	Cobb Creek Community EE Center	K-5 students			
Field trips	Delaware Earth Force				
Field trips	Wagner Free Institute				
Field trips: science field trips for K-4 students	Interboro, Longstreth Elementary; Patterson Elementary; Widener Charter	K-4 students			Interboro: 500–1000 Widener Charter: 24/year Patterson: couple times a year
Field trips: sustainability, green building, watershed content	PA Resources Council				
Field trips	PA Sea Grant	school groups	local		400
Field trips	Philadelphia Horticulture Society				
Field trips: brings summer camp kids to Refuge	Philadelphia Zoo	youth		90	
SCA	SCA	Youth, counselors, adults		76 (55 kids, 10 counselors, 10 adults)	

Table H.7. Onsite Training for Teachers and Pre-service Teachers.

Title and description	Organizations involved	Audiences served	Proximity of audience to Refuge	Numbers served	Frequency of programs
Professional Development: teacher training	Interboro School District; Patterson Elementary School	teachers	area	70	
Project Wet, Wild, Learning Tree Training, PA Songbirds, and so forth: teacher training in specific EE curricula	Penn State and University of Penn (pre-service teachers); area schools (in-service teachers)	teachers (pre-service and in-service)	local and area	100–200/year	
Summer Teacher Institute: week long workshops for K-5 teachers	Widener Partnership Charter School	K-5 teachers	Chester area	20–30/year	week long

Table H.8. Onsite Research.

Title and description	Organizations involved	Audiences served	Proximity of audience to Refuge	Numbers served	Frequency of programs
Water research: water research with Refuge biologists	Philadelphia Academy of Natural Sciences; National History Museum				
Bird Inventory: biological (bird and bird strikes) inventory with Refuge staff	Delaware Valley Ornithological Club				
University Biology field trips: college research field trips	Delaware Valley College, Drexel University, UPenn, and so forth	university biology students and graduate researchers	area		
Frog Watch USA: volunteers collect frog data at Refuge	Philadelphia Zoo, National Wildlife Federation	volunteers; citizen scientists			

Table H.9. Onsite Meetings and Retreats.

Title and description	Organizations involved	Audiences served	Proximity of audience to Refuge	Numbers served	Frequency of programs
Annual staff retreat	Bartram Gardens	garden staff			
Staff meetings	EPA	staff			
Staff meetings	PA Research Council (PRC)	staff			

Table H.10. Offsite Events or Festivals in which John Heinz NWR Participates.

Title and description	Organizations involved	Audiences served	Proximity of audience to Refuge	Numbers served	Frequency of programs
Green Recycling Festival	Philadelphia Airport	community and families	local and area residents; national and international travelers		once per year
Bucks County Sportsman Show	local Sportsman Group	community and families	local area residents	2,000	annual

Table H.11. Offsite Presentations or Programs Presented by John Heinz NWR Staff.

Title and description	Organizations involved	Audiences served	Proximity of audience to Refuge	Numbers served	Frequency of programs
Guest speaker	Refuge	University students	area universities		
Requested programs	Refuge	Rotary Clubs, Senior Centers, Career Days, Disabled Adult Centers	local and area residents	100-300/year	

Refuge Partnerships

This section reports on two different aspects of refuge partnerships: (a) existing partnerships, and (b) potential partners.

Current Partnerships

There are three highly developed partnerships at the refuge worthy of special note. Two of them involve elementary schools and/or elementary school teachers, and one is at the University Level.

- *Nature of Learning* is a multi-faceted partnership with the entire Interboro School District that includes professional development, integration of refuge resources into science curriculum, field-trips by all K–5 students, and offsite visits by refuge staff. This partnership is longstanding and mature. All of staff seems to agree it is ripe for replication to other school districts.
- *Widener University* students are trained by refuge staff in Project WET, WILD, and Learning Tree. Graduate (master's level) students also participate in the 5-week Saturday Ecology Academy for teen girls as part of their field study requirement. Stemming from the University partnership, The Widener Partnership Charter School is becoming a refuge partner through field trips (funded by Friends of Heinz Refuge), some requests for staff training, and utilization of loan boxes.
- *Refuge Environmental Education Development (REED) Team* is a consortium of teachers from Interboro School District, Patterson Elementary, Longstreth Elementary, and others who have written refuge-specific curriculum. This group is currently inactive, though according to staff they could be easily engaged if there was a project for them to embrace.

Potential Partners

Table H.12 lists potential environmental education partners for the refuge.

Table H.12. Potential Environmental Education Partners for John Heinz NWR.¹

Agency name	Consumer of EE (Audience) (C)	Provider of EE (P)	Exhibitor at Refuge events (E)
12 District Advisory Council	C	P	
American Philosophical Society			E
Art Organizations (Local)	C	P	E
Aurora Academy (online)			
Bailey Foundation Exotic Bird Rescue			E
Birding Club of Delaware County		P	E
Boys and Girls Club	C	P	
Brandywine Zoo		P	E
Clean Air Council	C	P	
Commonwealth Academy (online)			
Conservation Fund			E
Darby Creek Valley Association		P	E
Delaware Bay Estuary		P	E
Delaware County Herpetological Society	C	P	
Delaware County Libraries			E
Delaware Department of Natural Resources and Environmental Conservation		P	
Delaware Museum of Natural History		P	E
Delaware River Basin Commission		P	E
Delaware Riverkeeper Network			E
Delaware Valley Ornithological Club (DVOC)		P	E
DELCO Bird Club			
East Coast Greenway		P	
Energy Coordinating Agency of Philadelphia		P	E
Fairmount Park	C	P	
Forest Partners International			E
Forgotten Friend Reptile Sanctuary			E
Fort Mifflin		P	E
Franklin Institute		P	E
Friends of Wissahickon and other Friends Groups		P	E
Great Valley Nature Center		P	E
Hawk Mountain		P	E
Keep Your Cats Indoors			

Agency name	Consumer of EE (Audience) (C)	Provider of EE (P)	Exhibitor at Refuge events (E)
Kinder Garden native Seed Project			
Local colleges and University science and education departments	C	P	
Longwood Gardens		P	E
Mill Grove Audubon Center		P	E
Morris Arboretum		P	E
National Audubon Society –PA		P	E
Nature Conservancy		P	
New Jersey Adventure Aquarium		P	E
New Jersey Audubon – Cape May Bird Observatory		P	E
New Jersey Audubon – Rancocas Nature Center		P	E
North American Butterfly Association			E
Pennsylvania Association for EE		P	
Pennsylvania Dept of Conservation and Natural Resources		P	
Pennsylvania Dept of Education		P	
Pennsylvania Dept of Environmental Protection		P	E
Pennsylvania Fish and Boat Commission		P	E
Pennsylvania Game Commission		P	E
Pennsylvania Natural Heritage Program			E
Pennsylvania State Commission on Higher Education		P	
Pennsylvania State Parks (Ridley Creek)			E
Pennsylvania Environmental Council		P	E
Philadelphia Dept Parks and Rec.	C	P	
Philadelphia (City of)	C		
Philadelphia County			
Philadelphia Library System	C	P	
Philadelphia Trail Club	C		E
Philadelphia Water Department		P	E
Police Athletic League (PAL)	C	P	
School: Pepper Middle School	C		
School Districts: Penn-Delco, Philadelphia, Ridley, Southeast Delaware County, Upper Darby, William Penn	C	P	
Schuylkill Center for EE		P	E
The Avian Promise			E

Agency name	Consumer of EE (Audience) (C)	Provider of EE (P)	Exhibitor at Refuge events (E)
Tri-State Bird Rescue and Research, Inc.			E
Tyler Arboretum		P	E
U.S. Coast Guard		P	E
U.S. Sportsman's Alliance Trail Blazer Program			E
USDA – APHIS/Wildlife Services			E
Western Pennsylvania Conservancy			E
YMCA	C	P	

1. Extracted from Original Data Sheets- see Appendix B.

Outreach Materials

Although the primary focus of this project is on audiences, visitors, and potential partners, it is difficult to ignore existing outreach materials that help convey the image of the refuge and serve to attract, inform, and educate the visitors. This section briefly reviews select printed material and website information that are relevant to the purpose of this project.

Table H.13 is a list of printed refuge materials as provided by the refuge. The refuge also hosts a Web site that serves visitors to and audiences of the refuge.

Table H.13. Summary of Select Refuge Outreach Printed Material.

Title	Brief description
John Heinz National Wildlife Refuge at Tinicum	multi-page, 4-color, agency brochure of refuge with foldout map
Special event flyers	announcement for the annual festivals
Environmental education at John Heinz National Refuge at Tinicum	1 page, tri-fold brochure (black and white copy on salmon paper) summarizing programs, provisional development and field trip opportunities.
Quarterly walk schedules	1 page (legal), 4-fold brochure summarizing quarterly guided nature programs
Visitor Center	1 page (legal), tri-fold brochure (black and white copy on bright green paper) describing the green building design elements of the visitor center.
Impoundment trail map	1 page (letter) map of refuge trails (black and white copy)
10 th Annual Friends of Heinz Refuge photo group photo contest	1 page (letter) flyer/application for photo contest (black and white copy)
Heinz Refuge scouting award	1 page (legal), tri-fold flyer application and description of the Award program (accompanied by a 1 page flyer entitled "Notes to all Refuge Staff and Volunteers announcing this New Program – July 11, 2010)
Fishing opportunities brochure	
Canoe trail brochure/map	
Marsh musings	Friends quarterly newsletter (also friends membership brochure)

Title	Brief description
Online curriculum	http://www.fws.gov/heinz/ee.htm
Wildlife checklists	

Discussion

The refuge clearly makes connections with a large and diverse audience. It serves more than 125,000 visitors annually through onsite and offsite programs as well as self-guided visitors coming to enjoy the refuge. The variety of programs at the refuge reflects the interests, passions, and skills of staff, volunteers, and area stakeholders and partners.

The CCP process provides an excellent opportunity to craft a vision for the refuge's expanded role in the region's environmental education. The refuge will be positioned to develop its priorities and an action plan to achieve its preferred goals. As the refuge expands its environmental education efforts, it will need to expand its approach as well. The current "Train the Trainer" approach will need to become one of several strategies.

Staff is well versed about the unique environments of and issues related to the refuge. As such, they have the potential for significant environmental education impact through increased direct contact with visitors. Sharing their expertise with field trips through "meet and greets," guided tours, and end-of-trip debriefs would result in thousands of children having a satisfying and enriching experience that may entice them to bring friends and family back to the refuge. Utilizing staff's expertise for the development and delivery of programs specific to the refuge's identified niche would provide a perceived quality and depth of experience for participants. The orchestration of a formal volunteer program, complete with high quality training and evaluation, could provide additional needed resources. In this way, volunteers can directly assist the refuge in achieving its prioritized goals while the content, quality, and consistency of programs are ensured.

To successfully expand the refuge's role in environmental education, it is critical to look both inside and outside the organization. Internally, a focus on existing organizational strengths and capacity will shape what is possible to deliver. Externally, it will be important to learn who the refuge's stakeholders and potential partners are and to gain a clear picture of what is currently being done regarding environmental education in the region.

Gaining an Internal Perspective

Consideration No. 1 – Understanding Strengths

The refuge can leverage its position in environmental education by understanding its strengths. The refuge has natural features like its fresh water tidal marsh ecosystem that many people have not experienced. The urban location of the refuge is also unique and lends itself, like few other wildlife refuges, to connections with a huge and diverse population. As part of the CCP process, the refuge staff will want to articulate the uniqueness of the refuge in terms of its natural features, wildlife, and environmental issues. This will also help inform Phase II of this Stakeholder Analysis and the refining of the refuge's niche in environmental education.

Consideration No. 2 – Expanding Partnerships

Building on the strengths of the organization's existing partnerships will help achieve environmental education goals while maximizing resources. The refuge has at least three mature partnerships that

demonstrate the power of mutually-beneficial collaboration. Seeking ways to expand and replicate these alliances could produce dramatic results with considerably less effort and resources than would be necessary to capture a brand new audience with a newly developed program. *The refuge staff may consider identifying partners most aligned to REED and to the partnerships with Interboro School District and Widener University with the intent to replicate existing efforts with other partners.*

Consideration No. 3 – Understanding Internal Capacity

Understanding the refuge's capacity will help refine how to best grow environmental education programming. Capacity can, and should be, looked at in two ways—first with regard to limits on visitation and program participation, second with regard to internal resources. Growth in environmental education programming will most likely necessitate growth and/or the redefining of internal capacity. *Simultaneous to Phase II interviews, refuge staff may want to brainstorm answers to internal capacity questions such as:*

1. What does the refuge have to offer that nobody else can offer? For example, an answer may be the actual refuge property, the ability to offer free programs, or access to government agencies.
2. How many people can be accommodated onsite hourly, daily, annually, and in programs?
3. How many people can be reached offsite and online?
4. With our current staff, what are we capable of delivering?
5. What do we wish we could do in environmental education?
6. What are the barriers to achieving those wishes and how can we overcome them?
7. Do we have additional financial, staff, or volunteer resources available to us? Are there ways to attain any or all of them? How can we incorporate these anticipated resource needs into CCP planning?
8. When we decide on what programs we are going to deliver, how will we get our desired audience to come/participate? What promotional strategies do we need to employ? Will it be Web-based, mailing list, neighborhood flyers, e-mail?
9. When people come to our newly developed programs, how will we track attendance?
10. How will we measure if we are successful and if people's expectations were met, or what input they might have regarding improvement and future opportunities?
11. What types of technologies do we want to incorporate into our environmental education program (for example, in-house videos, live broadcasts, using satellite equipment now installed to expand programs, cell phone tours, and/or social networking)?

Gaining an External Perspective

Consideration No. 4 – Understanding Stakeholders

Understanding the region's stakeholders is a complex task. Not only is it important to know who they are and what they want, but ultimately it is desirable to craft a plan that truly responds to the needs of the area. In thinking about a refined vision for environmental education at the refuge that is responsive to the needs of the environmental education community, it is important to better understand these stakeholders: not only the other providers of environmental education in the area, but the current or potential consumers as well (for example, students and nonprofits such as Boys and Girls Club). For environmental education consumers, Phase II will explore overarching questions such as:

1. Are they aware of the refuge and to what extent?
2. Are they aware of the Refuge System mission, for example, "Wildlife First?"
3. Have they visited the refuge? If so, what was their impression?
4. If they have not visited, why not? What are the barriers?
5. Have they gone to other similar places for environmental education/interpretation?
6. Have they ever participated in a program or event at the refuge or at other similar places like nature centers and so forth?
7. What type of program or event would they attend?
8. Have they ever seen any marketing materials for the refuge or visited the website?
9. How would it be best to inform potential visitors of the refuge and its programs?

Consideration No. 5 – Inventorying Existing Regional Environmental Education

The public has many options in the region for environmental education. Refuge staff has often indicated that there are more than 40 entities nearby that all offer different approaches to environmental education. Carefully surveying other organizations with similar missions regarding their existing environmental education efforts will help sharpen the focus on what gaps exist in regional offerings. Information can also spawn creative thinking regarding options for partnering. With a subset of these environmental education providers, Phase II will explore questions such as:

1. Which other organizations in the region conduct environmental education?
2. What are the program strengths?
3. What are the perceived weaknesses?
4. Who is the audience? How have they been segmented and/or prioritized?
5. What are the challenges?

6. Who do they wish they could serve but cannot engage?
7. What do they see as the refuge's greatest opportunity to complement other environmental education initiatives in metropolitan Philadelphia?
8. Is there a way to collaborate to surmount challenges, to engage an audience who is difficult to reach, or to achieve something together that neither could achieve alone?

Next Step: Phase II Stakeholder Interviews

Phase II of this project will continue with the researchers conducting a series of interviews to explore the questions proposed in Considerations 4 and 5, above. The following steps are proposed to begin this process:

1. Build a list of potential interviewees from the information captured so far in Phase I (see Appendix B). This list will likely be more than can be accommodated in this study. Researchers will work with planning and refuge staff to narrow down this list to 15 to 30 interviewees.
2. As discussed above, partners/potential partners will be identified under both of the categories and sectors below:
 - I. Environmental Education Consumers (refuge is seeking an audience from these groups; Consideration No. 4)
 - A. Grades Pre-K to 12
 - Pre-K to 3
 - Grades 4 to 8
 - Grades 9 to 12
 - Special Education
 - Administrators
 - Teachers
 - School districts likely to replicate Interboro partnership
 - Homeschoolers
 - B. Universities and Colleges
 - Faculty in Pre-service Teacher program
 - Faculty in Architecture/Green Building/Sustainability programs
 - Faculty in Environment Resources/Water Quality programs
 - Universities likely to replicate Widener University partnership

- C. Other Entities with Overlapping Audiences
 - Youth organizations
 - Birding organizations
 - Senior citizen organizations/centers
 - Libraries
- II. Environmental Education Providers (refuge is seeking partnerships with these groups or wants to learn what is being done already by these groups; Consideration No. 5)
 - A. Aquariums
 - B. Nature Centers
 - C. Museums
 - D. Gardens/arboreta
 - E. Zoo
- III. Other
 - A. Funders (such as Conservation Fund)
 - B. Government Agencies
 - C. Representative Organizations for:
 - low-income populations
 - ethnic populations
 - teen, senior, or other demographic sector
- 3. Create a sampling strategy that allocates resources and effort fairly across these sectors. For example, a proportional sample of each of the sectors by grade level or type of organization may be appropriate. Snowball sampling may also be used as necessary to identify the most appropriate interviewee(s) representing each group.
- 4. Develop draft interview protocols for interviews. These protocols would draft procedures and actual questions to be used with each sector. At least two pilot interviews would be conducted prior to finalizing the protocols and proceeding with interviews.
- 5. Conduct interviews, compile and organize data, and report findings.

Appendix A

Summary of Recommendations from Visitor Services Review by Ten Visitor Services Criteria

As a reference and reminder only, the following phrases summarize recommendations made by the Review Team in the 2009 Visitor Services Review. Reader should reference the full report for additional level of detail.

Bold = VSR recommended planning efforts

Underline = refuge additions

1. Develop a Visitor Services Plan.

- Finalize **current VSP draft**.
- Clear strategy
- Refuge's issues and message
- Two new staff (supplement with high quality trained volunteer program)

2. Welcome and orient visitors.

- Move directional signs.
- Clarify visitor entrance.
- Provide basic information when closed.
- Replace canoe launch sign.
- Replace fishing signs.
- New approach on Route 420 and maintain 420 parking areas
- Replace kiosk on Route 420.
- Explore new media (Facebook, Twitter) as well as coordinate with External Affairs and Friends group who are currently using social media.

3. Provide quality hunting opportunities.

- Consider sharpshooters for deer management.
- Include **Outreach planning** in deer management.
- Consider public hunt (later)—youth, women, accessible.
- Address deer management in CCP.

4. Provide quality fishing opportunities.

- Develop **Fishing Plan**.
- Post regulations.

- Improve fishing access with signage.
- Replace bulletin board with interpretation signs.
- ID fishing areas on maps and brochures—consistency.
- Link fishing webpage to regulations and maps.
- Promote fishing activities.
- Create new fishing area—accessible.
- Info about live bait.
- First time fishing tip sheet.
- Tackle box supplies.
- Volunteer cleanup of fishing areas; current info.

5. Provide quality wildlife observation and photography opportunities.

- Clear bench areas.
- Renovate and maintain photo blinds; remove old blinds.
- Replace benches; place strategically.
- Add spotting scopes, seating, and bird ID interpretation at tower.
- Provide info and interpretation about wildlife watching.
- Link remote viewing area to monitor in Visitor Center.
- Install scopes with focusable lenses.
- Ensure at least one blind is accessible.
- Ensure one or both photo blinds are accessible.
- Ensure photo blinds are accessible.
- Photo group workshops, tours, and programs.
- Create web sites links to NANPA and other partner photo organizations.
- Continue annual photo camps, photo contest, and TTL programs.

6. Develop and implement a quality environmental education program.

- Develop **Environmental Education Plan** (revise/update).
- Encourage staff collaboration.
- Interns.
- Visitor-staff interaction.
- Increase visitor-staff interaction with staff led programs.
- Mentor more new educators through leading environmental education programs by example.

- Evaluation.
- Email communication about programs.
- Recruit youth and volunteers, mentors.
- Form partnerships with informal education entities.
- Schoolyard Habitat Program.
- Heinz family foundation philanthropies.
- Have more science and career fairs.
- Expand environmental education efforts beyond Philadelphia and Delaware Counties.

7. Provide quality interpretation of key resources and issues.

- Develop **Interpretation Plan**.
- Add site signs with maps.
- Improve native plant garden.
- Develop trail guide brochure with map.
- Improve canoe trail brochure.
- Expand topics of walks/talks; include refuge management activities.
- Include Refuge System information in all programs.
- Work with Friends group to take active role in preparing and presenting programs.
- Work with volunteers and Friends group to increase programs.
- Develop cell phone tours.
- Increase range of programs to other ages (ages 3 to 7)
- Add synopsis to list of programs.
- Interpretation training for staff.
- Increase programs given by staff.
- Explore funding for women in outdoors.

8. Manage for other recreational use opportunities.

- Link recreation to refuge resources.
- Educate all refuge visitors about Refuge System.
- Personal contact with visitors to refuge.

9. Communicate key issues with offsite audiences.

- Finalize **Outreach Plan** (internal and external needs assessment)—ID range of audiences, ID key messages, match message and media, include evaluation.
- Formalize partnerships to maintain and grow programs for at-risk youth.
- Enhance connection with neighborhood block party, visit classes, teen docents.
- Email communication with visitors to Visitor Center.
- Tech outreach—podcasts, websites, videos, cable TV, and so forth.
- Refuge blog.
- Elected officials—press kits, guided tours, personal connections.
- Partnership with Philly Zoo.
- Partnerships with transportation, hotels, Liberty Bell, local events, Philly Eagles.
- Connect to tourism agencies.
- Develop/host specific media days for reporters, editors, producers, and so forth.

10. Build volunteer programs and partnerships with Friends organizations.

- Maintain current volunteer agreements.
- Use NCTC scholarships.
- Pursue advanced volunteer training (NCTC).
- Volunteer handbook, recognition, and database program
- Add volunteer positions—teen docent, refuge host, coordinator, restoration team.
- Improve staff and Friends communication.
- Clarify refuge mission for Friends.
- Friends-only programs, trips, tours, events; Train Friends—books, materials, listserv/e-mail info, and so forth.

Appendix B

Original Data Worksheets

(Also available in the original Excel file format)

This appendix contains the following four Excel worksheets used in the initial data capture for this project.

- *Visitor Data*: the master file used for several iterations of data gathering related to actual visitation to the Visitor Center and the refuge at large.
- *Current Programs*: the master file for all programs provided by staff (refuge manager, visitor services supervisor, environmental education specialist, and public affairs staff).
- *Festival List*: electronic format of the hard-copy list provided by refuge manager in initial interview describing agencies who have had a booth or done a presentation at refuge festivals such as Cradle of Birding. When creating the electronic format, researchers added information regarding websites, some contact information, and distances from the refuge.
- *Current and Potential Partners*: master file for partnership information gathered from interviews and communication with staff, Refuge Management Habitat Plan, and 2002 EETAP Report.

Current Visitor Data for John Heinz Refuge (July 2010)				Gray areas are alternative ways to consider visitor data. If data exists please fill in otherwise leave blank. Add additional columns as needed to capture data you have. ¹										
FISCAL YEAR (Oct-Sept)	Total # of visitors to Refuge (based on 5x visitor center)	Total # of visitors into Visitor Center	Total # of offsite visitor contacts	Total # adults visiting	Total # children visiting	Total # field trip children visiting	Total # non-field trip children visiting	# of visitors receiving guided tours	# of teachers trained	# of classes taught	# of classes hosted (space only provided)	# of equip borrows	# offsite programs delivered	# of offsite people serviced offsite
2010 Oct thru July	100925	20185				4111		1335 S & V	140 S	15 V		~10	15 S & V	1165 S
2009	132830	26566				FY 09 - 8196		13283 S & V	FY - 305				30 S & V	1800
2008	116530					FY 08 - 7797		2450 S & V	FY - 266				25 S & V	500
2007	238190					FY 07 - 7087		4765 S & V	FY - 293				25 S & V	500
2006	106491							2130 S & V					20 S & V	400
2005	100920													
2004	104305												176 S & V	24364
2003	93200													
2002	118280													
2001	108290													

¹S and V indicate Staff and Volunteer

Current Programs at John Heinz Wildlife Refuge (July 2010)								
Program Name	Brief Description	Partner(s)	Target Audience	# of people served annually	Refuge's Role	If it's a deliverable program, who delivers it?	Program Origin: In- or Outreach?	CCP Focus Area ¹
Art Exhibits	Nature-based art exhibits hosted in Multipurpose Room throughout the year featuring regional artists		local community				Unknown	visitor services
Big Brothers Big Sisters Intro Program	600 "Bigs and Littles" hosted at refuge to introduce them to opportunities available at the refuge	Big Brothers, Big Sisters	Big Brother & Big Sister "big/little" duos	600	develop and deliver program	staff and volunteers	Unknown	visitor services
Cradle of Birding Wildlife Conservation Festival	Annual wildlife outreach event hosted at refuge with 36 exhibitors		local community	600-800	host and coordinate event	all staff effort	out-reach	refuge manager
Darby Creek Clean Up	Annual refuge clean up	see festival list	local community	150-250	logistics, lunch, event coordination	staff and volunteers	both	visitor services
Earth Day Darby Creek Clean-up	litter clean at refuge that results in pick up of 5-8 tons of trash each year	Waste Management, Friends of Heinz Refuge	local community	200	host and coordinate event	staff and volunteers	out	visitor services
Family Nature Program	monthly 4 hour family program that includes a lecture then hands-on experience in refuge		8-14 year olds	25-40	create and run program	staff and volunteers	both	visitor services
Federal Junior Duck Stamp Program	K-12 art competition. Refuge serves as the collection and judging site for Pennsylvania entrants with the refuge's manager serving as State coordinator.		students K-12 Statewide	450	coordinate State level competition		out	refuge manager
Fishing Camps	YMCA brings their youth fishing camps (with their own staff and equip) to use refuge	YMCA			provide use of refuge	YMCA	In-reach	visitor services
Green Building Tours	tours of Marsh Machine and explanation of green technology used in building Visitor Center		university architecture classes	100	develop and deliver program	staff and volunteers	In-reach	visitor services

Current Programs at John Heinz Wildlife Refuge (July 2010)									
Program Name	Brief Description	Partner(s)	Target Audience	# of people served annually	Refuge's Role	If it's a deliverable program, who delivers it?	Program Origin: In- or Outreach?	CCP Focus Area ¹	Staff Contact
Guest Speaker	provide guest lectures	area universities/ colleges	college students		provides guest speaker	refuge manager	In-reach	I	refuge manager
Heinz Scouting Award	Conservation awareness and activity guide for scouts that culminate in a Heinz Refuge patch award	Boy Scouts, Girl Scouts	Scouts	new	provides curriculum, Friends group provides patch	Scouts do it themselves	out	I	visitor services
International Migratory Bird Day	Festival type booths and programs hosted at refuge	varies from festival list	local community	100	host and coordinate event	staff and volunteers	out	I	visitor services
Micro Adventures	Older students mentor younger students when brought to refuge to collect samples and learn to use microscopes. They take samples back to classroom for longer term observation.	Interboro School District, Philadelphia Mennonite High School, and a middle school from NJ	entire 5th grade from Interboro School District, students from Philadelphia Mennonite HS (primarily intercity youth), and students from a middle school from NJ	350	hosts and delivers program	Public Affairs & AV	In-reach	EE	Public Affairs & Media
National Wildlife Refuge Week	Festival type booths and programs hosted at refuge. Also includes waterfowl carving demos and State's Junior Duck Artists.	varies --see festival list	local community	100	host and coordinate event	staff and volunteers	out	I	visitor services
Nature of Learning	A multi-faceted partnership with entire school district that can include offsite visits from refuge staff, professional development for teachers, and the integration of refuge resources into the science curriculum.	Interboro School District (4 elem schools)	Teachers and K-5 grade students come every year	500-1,000	host field trips, conduct teacher trainings, school visits	EE Specialist	Unknown	EE	EE Specialist

Current Programs at John Heinz Wildlife Refuge (July 2010)									
Program Name	Brief Description	Partner(s)	Target Audience	# of people served annually	Refuge's Role	If it's a deliverable program, who delivers it?	Program Origin: In- or Outreach?	CCP Focus Area ¹	Staff Contact
Nature walks	weekly/monthly programs on birds, trees, flowers, butterflies, etc.		local community	500-600	hosts and delivers program	staff and volunteers	both	I and WO	visitor services
Off site programs	programs as requested such as speaking at Rotary Clubs, afternoon programs for disabled adults, senior center programs, career days for universities,		local organizations	100-300	develop and deliver program	staff and volunteers	In-reach	I	visitor services
Owl Walks	seasonal evening bird walks		local community	30-40	create and run program	staff and volunteers	both	I	visitor services
Pathways to Fishing	Two annual free fishing days at refuge that coordinate with Statewide free fishing days. Free loaner fishing equipment provided.	PA Fish & Boat Commission	local community	75-150	provide free fishing rods, reels, bait, and fishing instruction	staff and volunteers	both	F	visitor services
Professional Development	Teacher Training for Interboro School District and Patterson Elementary School	Interboro School District, Patterson Elementary School	teachers	70	conduct professional development				
Project WET	science methods class from Penn State is put through Project WET each year	Penn State	Pre-service teachers	10	conduct teacher training	EE Specialist	Unknown	EE	EE Specialist
Project WET/ WILD/ Learning Tree, etc	Teacher Training/National Curriculum	area school districts, individual teachers, preservice teachers at universities	k-12 teachers and pre-service teachers	100- 200	conduct teacher training both on and offsite	EE Specialist	both	EE	EE Specialist
Saturday Ecology Academy	12-15 teen girls from underserved area of Chester are matched with Master degree program teachers and pre-service from Widener University (part of science methods class) for 5 Saturdays at the refuge. Teachers are evaluated on how well they deliver the curriculum to girls.	Widener University	Pre-service teachers and underserved teen girls	20	help develop curriculum for teen girls, host the program at the refuge, help evaluate pre-service teachers' delivery of curriculum	Dr. Nadine McHenry from Widener assisted by EE Specialist	both	EE	EE Specialist

Current Programs at John Heinz Wildlife Refuge (July 2010)									
Program Name	Brief Description	Partner(s)	Target Audience	# of people served annually	Refuge's Role	If it's a deliverable program, who delivers it?	Program Origin: In- or Outreach?	CCP Focus Area¹	Staff Contact
Scout Programs	programs designed to fulfill merit badge requirements	Scouts	Boy and Girl Scouts	75-100	create and run program	staff and volunteers	In-reach	I	visitor services
Spring Break/ Summer Camp	3 or 4 day camps for schools involved in Nature of Learning for 3rd and 4th grade students	Patterson, Widener, Longstreth Elementary Schools	3rd & 4th grade students	10 to 20 students per camp	host and lead camp	EE Specialist	both	EE	Specialist
Story Time	monthly family program		4-7 year olds	25-40	hosts and delivers program	staff and volunteers	both	I	visitor services
Summer Institute	Week-long intensive workshop at the refuge for all K-5 teachers from Widener Partnership Charter School (WPCS), a "lab" school for Widener University	Widener University & Widener Partnership Charter School	K-5 teachers	20-30	host, co-teach	EE Specialist and Widener Faculty	both	EE	Specialist
Summer Nature/ Photography Camps	two 4.5 day nature and/or nature photography camps for 8-14 yr. olds	Friends of Heinz Refuge for funding	8-14 years old	30-50	create and run program	staff and volunteers	both	I	visitor services
Through the Lens	Nature photography program			10	develop and deliver program	Public Affairs & AV	out-reach	NP, WO	visitor services
Woodcock Walks	seasonal evening bird walks		local community	30-40	create and run program	staff and volunteers	both	I	visitor services
Field Trips/ Meeting Space	These groups all use refuge as a field trip destination and/or meeting space	ALL OF THE BELOW			host field trip, provide use of facilities				
		Academy of Natural Sciences							
	Zoo brings their summer camp kids to refuge.	Philadelphia Zoo							
		Wagner Free Institute							
		Pennsylvania Resources Council							

Current Programs at John Heinz Wildlife Refuge (July 2010)									
Program Name	Brief Description	Partner(s)	Target Audience	# of people served annually	Refuge's Role	If it's a deliverable program, who delivers it?	Program Origin: In- or Outreach?	CCP Focus Area ¹	Staff Contact
		PA SEA Grant							
		Cobbs Creek Community Environmental Ed Center							
	They bring their youth programs here; refuge also provides facility for staff meetings	EPA - Philadelphia							
		Forest Service - Newtown Square							
		Bartrams Garden	K-4	200+			Unknown	EE	EE Specialist
	There's one science teacher for all students K-4 in this school...he brings a couple of the grades each year.	Patterson Elem School							
	They focus on sustainability; they do field trips here due to the green building and water shed. They are facility challenged use the refuge's meeting space.	PA Resources Council (PRC)							
		Schuylkill Center for Environmental Education (SCEE)/Green Woods Charter School (onsite)							
		Delaware Valley Earth Force							
	field trips for biology students and graduate researchers	Drexel University							
	24 field trips per year	Widener Partnership Charter School							
	field trips for undergrad biology students	Delaware Valley College							

¹EE = Environmental Education, I = Interpretation, NP = Nature photography, WO = Wildlife observation, F = Fishing

Festival List for John Heinz National Wildlife Refuge									
Source ¹	Organization	Website	Minutes from Refuge	Miles from Refuge	Reach	Sector	Primary Content-Focus ²	Mission	Agency Address (may not be contact address)
FL	American Philosophical Society	http://www.amphilsoc.org	19	11	National	NGO	O	Promotes useful knowledge in the sciences and humanities through excellence in scholarly research, professional meetings, publications, library resources, and community outreach. This country's first learned society, the APS has played an important role in American cultural and intellectual life for over 250 years	104 South Fifth Street Philadelphia, PA 19106-3387 215-440-3400
FL	Bailey Foundation Exotic Bird Rescue	http://www.bailey-foundation.org	19	13	Regional	NGO	B	Dedicated to enhancing the life of Companion Birds through Education, Rescue, Rehabilitation and Adoption	The Bailey Foundation P.O. Box 2122 Boothwyn, PA 19061 Phone: (484) 882-0101
FL	Bartram's Garden	http://www.bartramsgarden.org	8	4	City	NGO	P, E	America's oldest living botanical garden features an 18th century farmstead, native plants, wildflower meadow, and wetland.	5400 Lindbergh Boulevard Philadelphia, PA
FL	Bird Banding Demos				City		B	Bird Banding Demos	
FL	Birding by Ear		16	6	Regional	NGO	B	Bird ID by song	University of Pennsylvania Philadelphia, PA
FL	Birding Club of Delaware County	http://www.bcdelco.org	24	17	Regional	NGO	B, R	a birding club in Delaware County, Pennsylvania with the purpose to expand the individual interest and study of wild birds.	Meeting Location: Marple Township Library Meeting Room located at the intersection of Sproul and Springfield Roads in Broomall, PA

Festival List for John Heinz National Wildlife Refuge									
Source ¹	Organization	Website	Minutes from Refuge	Miles from Refuge	Reach	Sector	Primary Content-Focus ²	Mission	Agency Address (may not be contact address)
FL	Brandywine Zoo	http://www.brandywinezoo.org	29	22	City	public	A	Today, the Brandywine Zoo covers almost 13 acres of land and houses 150 animals. The Brandywine Zoo is managed by the Delaware Division of Parks and Recreation with the support of the Delaware Zoological Society. The Brandywine Zoo continues to be a fully-accredited member of the American Zoo and Aquarium Association,	1001 North Park Drive Wilmington, DE 19802-3801 (302) 571-7788
FL	Delaware Bay Estuary Project	http://www.fws.gov/delawarebay	82	65	Regional	public	E	The Delaware Bay Estuary Project is an office of the U.S. Fish and Wildlife Service (Service). The mission of the Service is working with others to conserve, protect, and enhance fish, wildlife, plants, and their habitats for the continuing benefit of the American people. Our office's specific mission is to: Work with partners to identify, restore, and protect regionally important habitat in the Delaware River drainage basin and the Delmarva Peninsula area.	Delaware Bay Estuary Project US Fish and Wildlife Service 2610 Whitehall Neck Rd. Smyrna, Delaware 19977-2910 (302) 653-9152
FL	Delaware County Herpetological Society	http://dvherps.wordpress.com	30	21	Regional	public	A	To promote education about and conservation of wildlife in general and herpetofauna in particular as well as to achieve a closer cooperation and understanding between amateur and professional herpetologists.	Maple Shade Soccer Club 895 E. Main St. Maple Shade, NJ
FL	Delaware Museum of Natural History	http://www.delmnh.org	36	26	State	NGO	E	To excite and inform people about the natural world through exploration and discovery.	4840 Kennett Pike Wilmington, DE 19807-1827 (302) 658-9111
FL	Delaware Valley Ornithological Club	http://www.dvoc.org/Main.htm	31	19	Regional	NGO	B	The Delaware Valley Ornithological Club (DVOC) is the organization for birders and bird enthusiasts in the Delaware Valley region.	Meeting held at Palmyra Cove Nature Park, Palmyra NJ

Festival List for John Heinz National Wildlife Refuge									
Source ¹	Organization	Website	Minutes from Refuge	Miles from Refuge	Reach	Sector	Primary Content-Focus ²	Mission	Agency Address (may not be contact address)
FL	Dept. of Bio Sciences, Univ of the Sciences in Philadelphia	http://www.usp.edu/academics/collegesDepts/BiologicalSciences	12	5	City		B, A, E	offers majors in biology, environmental science and microbiology	600 South 43rd Street Philadelphia, PA 19104-4418 (215) 596-8919
FL	Earth Force	http://www.earthforce.org	41	21	National	NGO	O	Earth Force engages young people as active citizens who improve the environment and their communities now and in the future.	100 Greenwood Avenue Wyncote, PA 19095 Phone (215) 884-9888
FL	Energy Coordinating Agency of Philadelphia	http://www.ecasavesenergy.org	19	9	City	NGO	O	The mission of the Energy Coordinating Agency (ECA) is to help people conserve energy and to promote a more sustainable and socially equitable energy future for the Philadelphia region.	1924 Arch Street Philadelphia, PA 19103-1404 (215) 988-0929
FL	EPA (Prentiss Ward-Children's Health Initiatives)	http://yosemite.epa.gov/oceph/ochpweb.nsf/content/whereyoulive2.htm			National	public	O	Protecting children's health from environmental risks...EPA Region 3 Children's Health Web Site: Learn about environmental issues that may affect children in the Mid-Atlantic. EPA Region 3's children's health coordinator is Prentiss Ward (ward.prentiss@epa.gov) at (215) 814-2813.	
FL	Forest Partners International		46	35	National	NGO	P	To promote sustainable natural resource management practices globally in regions of high biodiversity through partnerships that address biodiversity and human needs.	302 Poplar Road Flourtown, PA 19031
FL	Forgotten Friends Reptile Sanctuary (Forgotten Friend, Inc – 501(c)(3) nonprofit)	http://www.forgottenfriend.org	99	69	Regional	NGO	A	Nonprofit reptile rescue and education organization based out of Lancaster County, PA, with supporting members nationwide. Focused on educational outreach in the community and prevention of cruelty to animals.	Lancaster, PA

Festival List for John Heinz National Wildlife Refuge									
Source ¹	Organization	Website	Minutes from Refuge	Miles from Refuge	Reach	Sector	Primary Content-Focus ²	Mission	Agency Address (may not be contact address)
FL	Fort Mifflin	http://www.fortmifflin.us	6	3	City	public	E	The Fort is home to 14 restored historic structures constructed from 1778 to 1875, including an Enlisted Barracks, Officer's Quarters, Blacksmith Shop and the casemates (or as the students like to call them, the dungeons.) The Fort is situated on the beautiful banks of the Delaware River, where you can eat a picnic lunch and watch the abundant fauna and flora or investigate the ancient moat, which is home to all sorts of aquatic life.	1 Fort Mifflin Rd Philadelphia, PA 19153-3990
FL	Franklin Institute	http://www2.fi.edu	18	9	City	public	E, O	In the spirit of inquiry and discovery embodied by Benjamin Franklin, the mission of The Franklin Institute is to inspire an understanding of and passion for science and technology learning.	222 North 20th Street Philadelphia, PA 19103 215.448.1200
FL	Great Valley Nature Center	http://www.gvnc.org	46	27	City	NGO	E	Fosters an appreciation and understanding of the natural world and promotes a sense of responsibility for its care. A colonial-era fieldstone bank barn serves as the education building, having undergone renovations in 1986 and 2001. A converted farmhouse provides admin, teaching and meeting space, and houses the executive director and his family. A nearby two-storied springhouse probably predates the barn. The Nature Center's 10½-acre site includes a stream, a pond, and wetland, field, and woodland habitats. Also featured is a Birds of Prey Center, a replica Native American Lenape village, a Pennsylvania wildflower garden, a maple sugar house, and a please-touch exhibit area.	PO Box 82 Rt. 29 & Hollow Rds. Devault, PA 19432 Phone 610.935.9777

Festival List for John Heinz National Wildlife Refuge									
Source ¹	Organization	Website	Minutes from Refuge	Miles from Refuge	Reach	Sector	Primary Content-Focus ²	Mission	Agency Address (may not be contact address)
FL	Hawk Mountain	http://www.hawkmountain.org	108	91	Regional	NGO	E	Hawk Mountain is the world's first refuge for birds of prey. Open year-round, visitors enjoy scenic vistas, 8-miles of ridge and valley trails, a Visitor Center, Bookstore, and native plant garden, and each autumn, the chance to observe large numbers of hawks, eagles and falcons as they migrate past our lookouts.	1700 Hawk Mountain Rd Kempton, PA 19529 Phone: (610) 756-6961
FL	Keep Your Cats Indoors	http://www.njaudubon.org/SectionCatsIndoors/CatsIndoors.aspx			Regional	NGO	A	Millions of birds, small mammals, reptiles and amphibians are killed every year by domestic cats. Join Educator Walt Jennings and local students from Interboro School System to learn important ways that you can protect wildlife from these silent domestic and often feral predators.	
FL	Kinder Garden Native Seed Project – Longstreth Elementary School	http://www.riverfronttramble.org/heinz-schedule-2.pdf	12	5	City	public	P	Meet Chuck Lafferty and local students from Longstreth Elementary School's Kinder-Garden Seed Company to find out how they grow organic native seeds for wildlife habitat right here in Philadelphia.	Longstreth Elementary School N. E. Corner of 57th & Beaumont St Philadelphia 19143
FL	Longwood Gardens	http://www.longwoodgardens.org	37	26	City	NGO	P	Longwood Gardens is the living legacy of Pierre S. du Pont, inspiring people through excellence in garden design, horticulture, education and the arts.	Longwood Gardens 1001 Longwood Road Kennett Square, PA 19348
FL	John James Audubon Center at Mill Grove (The first home of John James Audubon in America)	http://pa.audubon.org/centers_mill_grove.html	44	33	Regional	NGO	B	Today, the National Audubon Society strives to connect people with nature within the special context of a national historic site and through the appreciation of John James Audubon's life and art. In the future the Center will tell the story of the stirring of the American conservation movement and the protection of birds, wildlife and habitat through the compelling art of Audubon.	John James Audubon Center at Mill Grove 1201 Pawlings Road Audubon, PA 19403 Telephone: 610-666-5593

Festival List for John Heinz National Wildlife Refuge									
Source ¹	Organization	Website	Minutes from Refuge	Miles from Refuge	Reach	Sector	Primary Content-Focus ²	Mission	Agency Address (may not be contact address)
FL	Morris Arboretum (UPENN)	http://www.business-services.upenn.edu/arboretum/index.shtml	42	31	Regional	public	P	An interdisciplinary center that integrates art, science and the humanities. Thousands of rare and lovely woody plants, including some of Philadelphia's oldest, rarest, and largest trees, are set in a romantic, 92-acre, Victorian landscape garden of winding paths, streams, flowers and special garden areas.	100 E. Northwestern Avenue Philadelphia, PA 19118
FL	National Audubon Society-PA				National	NGO	B		See Mill Grove above
FL	Cape May Bird Observatory, New Jersey Audubon Society (NIAS)	http://www.birdcapemay.org/contact.shtml	114	91	State	NGO	B, E, R	Founded in 1976 by the NIAS*, the Cape May Bird Observatory (CMBO) is a leader in research, environmental education, bird conservation, and recreational birding activities. Our mission: to understand and instill appreciation of the needs of resident and migrating birds so that human ambitions do not undermine them. *The NIAS is a privately supported, not-for profit, statewide membership organization. Founded in 1897, and one of the oldest independent Audubon societies, NIAS has no affiliation with the National Audubon Society.	The Northwood Center 701 East Lake Drive Cape May Point, NJ 08212 Ph: 609.884.2736
FL	NJ Adventure Aquarium	http://www.adventureaquarium.com	24	14	State	NGO	F		1 Riverside Drive Camden, NJ 08103-1060 (856) 365-3300

Festival List for John Heinz National Wildlife Refuge									
Source ¹	Organization	Website	Minutes from Refuge	Miles from Refuge	Reach	Sector	Primary Content-Focus ²	Mission	Agency Address (may not be contact address)
FL	NJ Audubon, Rancocas Nature Center, (Susan Buffalino-Director)	http://www.njaudubon.org/SectionCenters/SectionRancocas/Introduction.aspx	40	31	State	NGO	B, E, R	New Jersey Audubon has no connection with the National Audubon Society. New Jersey Audubon fosters environmental awareness and a conservation ethic among New Jersey's citizens; protects New Jersey's birds, mammals, other animals, and plants, especially endangered and threatened species; and promotes preservation of New Jersey's valuable natural habitats.	794 Rancocas Road Mount Holly, NJ 08060 609-261-2495
FL	North American Butterfly Association	http://www.naba.org	120	98	National	NGO	A	Working to increase public enjoyment and conservation of butterflies.	4 Delaware Road Morristown, NJ 07960
FL	PA Fish & Boat Commission	http://www.fish.state.pa.us	126	117	State	public	F, R	The mission of the Pennsylvania Fish and Boat Commission is to protect, conserve, and enhance the Commonwealth's aquatic resources and provide fishing and boating opportunities.	1601 Elmerton Avenue PO Box 67000 Harrisburg, PA 17106 717-705-7800
FL	PA Fish & Boat Commission	http://www.fish.state.pa.us	126	117	State	public	F, R	The mission of the Pennsylvania Fish and Boat Commission is to protect, conserve, and enhance the Commonwealth's aquatic resources and provide fishing and boating opportunities.	1601 Elmerton Avenue PO Box 67000 Harrisburg, PA 17106 717-705-7800
FL	PA Game Commission	http://www.portal.state.pa.us/portal/server.pt/community/education/9110	126	117	State	public	F, A, R	Managing wildlife and its habitat for current and future generations	2001 Elmerton Ave Harrisburg, Pennsylvania 17110 717-787-4250
FL	PA Game Commission	http://www.portal.state.pa.us/portal/server.t?open=512&objID=9115&mode=2	126	117	State	public	F, A, R	Managing wildlife and its habitat for current and future generations	2001 Elmerton Ave Harrisburg, Pennsylvania 17110 717-787-4250

Festival List for John Heinz National Wildlife Refuge									
Source ¹	Organization	Website	Minutes from Refuge	Miles from Refuge	Reach	Sector	Primary Content-Focus ²	Mission	Agency Address (may not be contact address)
FL	PA State Parks, Ridley Creek State Park	http://www.dcnr.state.pa.us/stateparks/parks/ridleycreek.aspx	29	18	State	public	E, R	Ridley Creek State Park encompasses over 2,606 acres of Delaware County woodlands and meadows. The gently rolling terrain of the park, bisected by Ridley Creek, is only 16 miles from center city Philadelphia.	351 Gradyville Road Newtown Square, PA 19073-2803 (610) 892-3900
FL	Pennsylvania Sea Grant	http://seagrant.psu.edu/seagindex.htm	13	8	State	public	O	Promotes the ecological and economic sustainability of PA's coastal resources through research and outreach. Our activities include science-based extension, education, applied research, and communication focusing on the Lake Erie and Delaware River drainages of PA.	Delaware River Office 1350 Edgmont Avenue Suite 2570 Chester, PA 19013 Phone: (215) 806-0894
FL	Philadelphia Academy of Natural Sciences, Natural History Museum	http://www.ansp.org	17	19	City	NGO	A, E	"The encouragement and cultivation of the sciences." The Academy's collection of more than 17 million cataloged natural history specimens and artifacts is among the ten largest in the United States.	1900 Benjamin Franklin Parkway Philadelphia, PA 19103-1101 (215) 299-1000
FL	Philadelphia Trail Club	http://m.zanger.tripod.com/index.htm	56	44	City	NGO	R	The Club (PTC) started in 1931 with 15 members who hiked 6 miles near West Chester, PA. The Club has been hiking ever since. In a recent year 163 members participated in 93 hikes for a total of 6207 miles. Hikes are led each Sat and Sun all year long except for July & Aug. In mid-summer, activities emphasize swimming, canoeing and picnics.	2142 Bristol Road Warrington, PA 18976
FL	Refuge REED Team (Resource EE Development)							A group of teachers working with refuge on formal EE curriculum development.	

Festival List for John Heinz National Wildlife Refuge									
Source ¹	Organization	Website	Minutes from Refuge	Miles from Refuge	Reach	Sector	Primary Content-Focus ²	Mission	Agency Address (may not be contact address)
FL	The Schuylkill Center for Environmental Education	http://www.schuylkillcenter.org	36	18	City	NGO	E	The mission of The Schuylkill Center is to promote, through environmental education, the preservation and improvement of our natural environment by: Fostering appreciation, understanding and responsible use of the ecosystem; Disseminating information on current environmental issues; Encouraging appropriate public response to environmental problems and; To maintain the facilities of The Schuylkill Center and conserve its land for the purpose of environmental education.	8480 Hagy's Mill Road Philadelphia, PA 19128
FL	The Avian Promise	http://theavianpromise.org	49	37	City	NGO	B	Education and the coordination of information about wild birds.	8785 Duveen Dr Wyndmoor, PA 19038 215-518-5029
FL	The Conservation Fund	http://www.conservationfund.org/node/210	162	136	National	public	O	Nonprofit that treats conservation as our business. Provide the skills, strategies and funds that partners need to fulfill conservation priorities swiftly and successfully. Partner with community, gov't and corporate leaders to protect America's outdoor places and to conserve resources for healthy, sustainable communities. No formal membership, charitable endowment or political agenda.	NATIONAL HEADQUARTERS 1655 N. Fort Myer Drive, Suite 1300 Arlington, VA 22209-3199 Phone: (703) 525-6300
FL	Tri-State Bird Rescue & Research, Inc.	http://www.tristatebird.org/about/history	48	36	Regional	NGO	B	To achieve excellence in the rehabilitation of injured, orphaned, and oiled native wild birds, with the goal of returning healthy birds to their natural environment. We do this through compassionate care, humane research, and education.	110 Possum Hollow Road Newark, Delaware, 19711

Festival List for John Heinz National Wildlife Refuge									
Source ¹	Organization	Website	Minutes from Refuge	Miles from Refuge	Reach	Sector	Primary Content-Focus ²	Mission	Agency Address (may not be contact address)
FL	Tyler Arboretum	http://www.tylerarboretum.org/index.asp	28	19	City	NGO	P	To preserve, develop, and share our diverse horticultural, historic, and natural site resources in order to stimulate stewardship and an understanding of our living world. Tyler encompasses 650 acres of horticultural collections, rare plant specimens, ancient trees, historic buildings, and extensive hiking trails.	515 Painter Road Media, PA 19063
FL	US Sportsman's Alliance Trail Blazer Program	http://www.usportsmen.org/Page.aspx?pid=261			National	NGO	R	The Trailblazer Adventure Program was designed to expose families to outdoor activities during the Trailblazer Adventure Day and offer them the chance to engage in the activities through the year-long Trailmaster mentoring program.	801 Kingsmill Parkway Columbus, OH 43229
FL	USDA-APHIS/ Wildlife Services	http://www.aphis.usda.gov/about_aphis/programs_offices/wildlife_services/	140	126	National	public	A	Wildlife Services (WS) provides Federal leadership and expertise to resolve wildlife conflicts and create a balance that allows people and wildlife to coexist peacefully.	USDA/APHIS/ LPA 4700 River Road Riverdale, MD 20737
FL	Wagner Free Institute of Science	http://www.wagnerfreeinstitute.org	24	13	City	public	F, A, P, E	Nineteenth century exhibit hall houses an extraordinary collection of natural history specimens. Gathered largely during the nineteenth century, the collections are displayed in cherry-wood and glass cabinets dating from the 1880s. Originally assembled to teach science, the specimens are arranged for study. The exhibit is one of the largest systematically arranged collections on display in the country and remains in active use as a key educational tool of the Institute's free science programs. It also serves as a resource for scholarly research.	1700 West Montgomery Avenue Philadelphia, PA 19121-3298 (215) 763-6529

Festival List for John Heinz National Wildlife Refuge									
Source ¹	Organization	Website	Minutes from Refuge	Miles from Refuge	Reach	Sector	Primary Content-Focus ²	Mission	Agency Address (may not be contact address)
FL	Western PA Conservancy	http://www.paconserve.org			Regional	NGO	E	Our Mission: The Western Pennsylvania Conservancy protects and restores exceptional places to provide our region with clean waters and healthy forests, wildlife and natural areas for the benefit of present and future generations. The Conservancy creates green spaces and gardens, contributing to the vitality of our cities and towns, and preserves Fallingwater, a symbol of people living in harmony with nature.	Allegheny Regional Office 40 West Main Street Ridgway, PA 15853-1634 (814) 776-1114
HMP	PA Fish and Boat Commission (PFBC)								
HMP	Partners in Flight								
HMP	PA Department of Conservation and Natural Resources (DCNR)								
HMP	Pennsylvania Natural Heritage Program								
HMP	Union of Concerned Scientists								
HMP	Intergovernmental Panel on Climate Change (IPCC)								
HMP	Philadelphia County								
HMP	Delaware Riverkeeper Network								

Festival List for John Heinz National Wildlife Refuge									
Source ¹	Organization	Website	Minutes from Refuge	Miles from Refuge	Reach	Sector	Primary Content-Focus ²	Mission	Agency Address (may not be contact address)
HMP	PA Department of Environmental Protection (PADEP)								
HMP	Philadelphia Water Department (PWD)								
HMP	Darby Creek Valley Association (DCVA)								
HMP	Delaware River Basin Commission								
HMP	Delaware Department of Natural Resources and Environmental Conservation (DNREC)								

¹FL = Festival List from Gary, ED = EETAP Document, HMP = Habitat Management Plan

²B = Birds/birding, F = Fish, A = Animals (non-bird/fish), P = Plants/flora, E = Ecology/natural history, R = Recreation, O = Other

Current and Potential Partners at John Heinz Wildlife Refuge						
Agency Name	Survey	Potential or Current Partner	Type of EE Partner ¹	Address	Description of current mission, purpose, facility, or resources	In what capacity COULD THEY BE or ARE THEY a partner?
12 District Advisory Council	Y	Potential	C, P			
American Philosophical Society		Potential	E			
Art Organizations (Local)	Y	Potential	C, P, E			Nature-oriented art classes at refuge
Aurora Academy (online)		Potential				
Bailey Foundation Exotic Bird Rescue		Potential	E			
Birding Club of Delaware County		Potential	P, E			
Boys and Girls Club	Y	Potential	C, P			Refuge could do programs there. But, can they get here for programs or field trips as a group?
Brandywine Zoo	Y	Potential	P, E			
Clean Air Council		Potential	C, P			
Commonwealth Academy (online)		Potential				
Conservation Fund		Potential	E			
Darby Creek Valley Association		Potential	P, E			
Delaware Bay Estuary		Potential	P, E			
Delaware County Herpetological Society	Y	Potential	C, P			
Delaware County Libraries		Potential	E		Public library facilities currently doing reading programs for children. They serve large numbers of people interested in informal learning.	Develop a nature-oriented reading program for kids, complete with awards to earn (via Friends of Heinz Refuge). Also, to expand number and scope of programs refuge does at the libraries.
Delaware Department of Natural Resources and Environmental Conservation		Potential	P			
Delaware Museum of Natural History	Y	Potential	P, E			
Delaware River Basin Commission		Potential	P, E			
Delaware Riverkeeper Network		Potential	E			

Current and Potential Partners at John Heinz Wildlife Refuge						
Agency Name	Survey	Potential or Current Partner	Type of EE Partner ¹	Address	Description of current mission, purpose, facility, or resources	In what capacity COULD THEY BE or ARE THEY a partner?
Delaware Valley Ornithological Club (DVOC)		Potential	P, E			
DELCO Bird Club		Potential				
East Coast Greenway	Y	Potential	P			
Energy Coordinating Agency of Philadelphia		Potential	P, E			
Fairmount Park	Y	Potential	C, P			
Forest Partners International		Potential	E			
Forgotten Friend Reptile Sanctuary		Potential	E			
Fort Mifflin	Y	Potential	P, E			
Franklin Institute	Y	Potential	P, E			
Friends of Wissahickon and other Friends Groups	Y	Potential	P, E			
Great Valley Nature Center		Potential	P, E			
Hawk Mountain	Y	Potential	P, E			
Keep Your Cats Indoors		Potential				
Kinder Garden native Seed Project		Potential				
Local colleges and University science and education departments	Y	Potential	C, P	Specifically Neumann University and St. Joe's	Pre-service teaching program	Integration of educational materials/workshops provided by the refuge into pre-service education programs
Longwood Gardens	Y	Potential	P, E			
Mill Grove Audubon Center		Potential	P, E			
Morris Arboretum	Y	Potential	P, E			
National Audubon Society –PA	Y	Potential	P, E			
Nature Conservancy		Potential	P			
New Jersey Adventure Aquarium	Y	Potential	P, E			
New Jersey Audubon – Cape May Bird Observatory	Y	Potential	P, E			

Current and Potential Partners at John Heinz Wildlife Refuge						
Agency Name	Survey	Potential or Current Partner	Type of EE Partner ¹	Address	Description of current mission, purpose, facility, or resources	In what capacity COULD THEY BE or ARE THEY a partner?
New Jersey Audubon – Rancocas Nature Center		Potential	P, E			
North American Butterfly Association		Potential	E			
Pennsylvania Association for EE	Y	Potential	P			
Pennsylvania Dept of Conservation & Natural Resources		Potential	P			
Pennsylvania Dept of Education	Y	Potential	P			
Pennsylvania Dept of Environmental Protection		Potential	P, E			
Pennsylvania Fish and Boat Commission	Y	Potential	P, E			
Pennsylvania Game Commission		Potential	P, E			
Pennsylvania Natural Heritage Program		Potential	E			
Pennsylvania State Commission on Higher Education		Potential	P			
Pennsylvania State Parks (Ridley Creek)	Y	Potential	E			
Pennsylvania Environmental Council		Potential	P, E			
Philadelphia Dept of Parks and Recreation	Y	Potential	C, P			
Philadelphia (City of)		Potential	C			
Philadelphia County		Potential				
Philadelphia Library System	Y	Potential	C, P		Public library facilities currently doing reading programs for children. They serve large numbers of people interested in informal learning.	Develop a nature-oriented reading program for kids, complete with awards to earn (via Friends of Heinz Refuge). Also, to expand number and scope of programs refuge does at the libraries.
Philadelphia Trail Club		Potential	C, E			

Current and Potential Partners at John Heinz Wildlife Refuge						
Agency Name	Survey	Potential or Current Partner	Type of EE Partner ¹	Address	Description of current mission, purpose, facility, or resources	In what capacity COULD THEY BE or ARE THEY a partner?
Philadelphia Water Department	Y	Potential	P, E			
Police Athletic League (PAL)	Y	Potential	C, P		Their athletic programs target at-risk youth.	Programs for youth incorporating hiking, maybe fishing, maybe biking (though impact would have to be kept to a minimum).
School: Pepper Middle School	Y	Potential	C			
School Districts: Penn-Delco, Philadelphia, Ridley, SE Delaware County, Upper Darby, William Penn	Y	Potential	C, P			
Schuylkill Center for EE		Potential	P, E			
The Avian Promise		Potential	E			
Tri-State Bird Rescue and Research, Inc.		Potential	E			
Tyler Arboretum		Potential	P, E			
U.S. Coast Guard		Potential	P, E			
U.S. Sportsman's Alliance Trail Blazer Program		Potential				
USDA – APHIS/Wildlife Services		Potential	E			
Western Pennsylvania Conservancy		Potential	E			
YMCA		Potential	C, P			
Academy of Natural Sciences	Y	Current	P			They bring summer camp groups here, they do “booths” at refuge festivals, refuge reciprocates for their festivals, they’re doing water research at refuge with refuge biologist.
Bartram's Garden	Y	Current	P	54 & Lindbergh Blvd. Phila., PA 19143		Nearby nature center--only 2 miles away--so easy to call on. They host a retreat at refuge for their staff; both agencies may invite each other's volunteers to general volunteer trainings (not site specific content); agencies share kudos such as behind the scenes tours for volunteers.

Current and Potential Partners at John Heinz Wildlife Refuge						
Agency Name	Survey	Potential or Current Partner	Type of EE Partner ¹	Address	Description of current mission, purpose, facility, or resources	In what capacity COULD THEY BE or ARE THEY a partner?
Big Brothers Big Sisters	Y	Current	C, P	1341 N Delaware Ave		They help market refuge programs to their audience; September Intro Program hosted for 600 “biggs and littles” at refuge to introduce them to refuge opportunities.
Cobbs Creek Community Environmental Educ Center (CCCEC)	Y	Current	C, P			Bring field trips here and they promote refuge programming. Refuge has done some workshops for them.
Delaware Valley College	Y	Current	C, P			They bring undergrad biology students for field trips, they provide volunteers and interns.
Delaware Valley Earth Force	Y	Current	C, P	100 Greenwood Ave Wyncote, PA 19095		Field trips
Delaware Valley Ornithological Club		Current	E			Works with refuge on biological inventory on birds and bird strikes (windows).
Drexel University		Current	C, P			Field trips for biology students and graduate researchers.
EPA	Y	Current	P, E			They bring youth programs here; refuge provides facility for staff meetings.
Friends of Heinz Refuge (FOHR)	Y	Current	P			Raises money for and financially supports refuge environmental education efforts and biological functions.
Friendship Circle Senior Center		Current	C, P	Mercy/Fitzgerald Hospital, Lansdowne, PA 19050		Refuge does offsite programs for them.
Girl Scouts of Southeastern Pennsylvania (SEPA)	Y	Current	C, P	PO Box 27540, Phila. PA 19118		They do a camp at refuge; refuge does badge programs for them on request; refuge periodically does adult training regarding available resources at refuge; they promote refuge and refuge programs
Interboro School District	Y	Current	C			Nature of Learning: Refuge provides professional development for teachers, field trips, works with schoolyard habitat
Longstreth Elementary School		Current	C			Field trips
PA Dept. of Education, Env. & Eco. Office		Current	P			They provide materials for Project Wet and Project Learning Tree (State organizer)
PA Game Commission		Current	P			They provide materials for Project Wild workshops (State organizer)

Current and Potential Partners at John Heinz Wildlife Refuge						
Agency Name	Survey	Potential or Current Partner	Type of EE Partner ¹	Address	Description of current mission, purpose, facility, or resources	In what capacity COULD THEY BE or ARE THEY a partner?
PA Resources Council (PRC)		Current	P			They focus on sustainability; they do field trips at refuge focused on the green building and water shed. They use the refuge's meeting space.
PA Sea Grant	Y	Current	C, P	4601 Market St. 2nd fl, Phila, PA 19139		They bring their EE programs and school groups to the refuge for field trips
Patterson Elementary School	Y	Current	C			Refuge provides professional development/field trips
Pennsylvania Environmental Education (PAEE)	Y	Current	P			They provide refuge workshop advertisement; refuge staff can go there for professional development
Pennsylvania State						Pre-service workshop--Project WET one day once a year
Philadelphia International Airport		Current	C	Terminal E, Phila. PA 19153		Refuge participates in Green Recycling Festival at airport each year and sometimes other festivals there; refuge is a frequent stop for people arriving early at airport to pick people up so front desk sometimes checks on incoming flights for those visitors (time permitting); airport staff uses refuge facilities as meeting space
Philadelphia Horticulture Society	Y	Current	C, P			They initiate a teacher training and use refuge resources when they bring field trip.
Philadelphia Zoo	Y	Current	C, P			Zoo brings summer camp kids to refuge. Refuge is a site where volunteers can collect data for Frog Watch USA, the Association of Zoos and Aquarium's "flagship citizen science program". Refuge brings live animals to refuge for festivals.
Refuge Environmental Education Development (REED) Team	Y	Current	P			A consortium of volunteer teachers from Interboro School District, Patterson Elementary School, Longstreth Elementary School and others. In the past they wrote curriculum specific to refuge for visiting groups (posted on web site). They are currently awaiting a new project.
Retired Senior Volunteer Program (RSVP)	Y	Current	C, P	609 W. State Street, Media, PA 19063		They are resource for refuge to get new volunteers.

Current and Potential Partners at John Heinz Wildlife Refuge						
Agency Name	Survey	Potential or Current Partner	Type of EE Partner ¹	Address	Description of current mission, purpose, facility, or resources	In what capacity COULD THEY BE or ARE THEY a partner?
Schuylkill Center for Environmental Education (SCEE)/Green Woods Charter School (onsite)		Current	C			Field trips
Student Conservation Association (SCA)	Y	Current	C, P			Refuge hosts 1 summer work camp, and coordinate 4 others in Philly area for 11 HS students and 2 group leaders for 6 weeks; 3 interns for 3 months each.
University of Pennsylvania		Current	C, P			Pre-service workshop--Project Learning Tree one day
US Coast Guard		Current	P	234 S. Davis Ave. Audubon, NJ 08106		Refuge just started to connect with them. Refuge provides an outlet for their boating and safety info; they are participating at refuge's festival; refuge has offered space for their boating class in hopes of reaching an audience that might not otherwise know about or come to the refuge.
US Forest Service		Current	P	11 Campus Blvd. Suite 200 Newtown Square, PA 19073		Refuge uses their Woodsie Owl and Smokey Bear costumes; on each other's radar screen--can always call them
Widener Partnership Charter School	Y	Current	C			Field trip participants 24 times per year
Widener University	Y	Current	C, P			Refuge provides teacher training for EE/ has been a guest instructor there. Students are exposed to Tool Kit. To fulfill the field study component for Master's Degree course, students participate in Saturday Ecology Academy for teen girls.

¹C = Consumer of EE (Audience), P = Provider of EE, E = Exhibitor at Refuge events

Appendix C

Documents and Sources Reviewed for this Project

U.S. Fish and Wildlife Service Documents

- U.S. Fish and Wildlife Service Visitor Services Planning: Spelling it Out
- U.S. Fish and Wildlife Service Writing Refuge Management Goals and Objectives: A Handbook (draft and final)

Refuge-specific Documents

- John Heinz at Tinicum National Wildlife Refuge Purposes, Draft Vision, Draft Goals
- John Heinz National Wildlife Refuge at Tinicum Habitat Management Plan July 2009
- John Heinz National Wildlife Refuge at Tinicum Visitor Services Review
- CCP Pre-planning for visitor services
- John Heinz National Wildlife Refuge organizational chart

Environmental Education and Interpretation-specific Documents

- Education Contacts From Festivals at John Heinz National Wildlife Refuge 2010
- Draft John Heinz National Wildlife Refuge at Tinicum Environmental Education Plan 2010
- John Heinz National Wildlife Refuge draft Environmental Education and Interpretation Goals, Objectives, and Strategies

Appendix I

Dan Salas/Cardno JFNew



Wild rice and spatterdock within Tinicum marsh

Sea Level Affecting Marshes Model (SLAMM) Report

Application of the Sea-Level Affecting Marshes Model (SLAMM 6) to John Heinz NWR

Prepared for:

U. S. Fish and Wildlife Service
National Wildlife Refuge System
Division of Natural Resources and Conservation Planning
Conservation Biology Program
4401 N. Fairfax Drive - MS 670
Arlington, VA 22203

December 9, 2010

Warren Pinnacle Consulting, Inc.
PO Box 253, Warren VT, 05674
(802)-496-3476

Application of the Sea-Level Affecting Marshes Model (SLAMM 6) to John Heinz NWR

Contents

Introduction.....	I-5
Model Summary	I-5
Sea Level Rise Scenarios.....	I-6
Methods and Data Sources	I-7
Bibliography.....	I-18

Introduction

This is the second application of the SLAMM model to John Heinz NWR. Since December of 2009, a new higher-vertical resolution elevation data set became available as well as additional information about the extent of diked and impounded portions of the study area.

Tidal marshes are among the most susceptible ecosystems to climate change, especially accelerated sea level rise (SLR). The Intergovernmental Panel on Climate Change (IPCC) Special Report on Emissions Scenarios (SRES) suggested that global sea level will increase by approximately 30 cm to 100 cm by 2100 (IPCC 2001). Rahmstorf (2007) suggests that this range may be too conservative and that the feasible range by 2100 is 50 to 140 cm. Rising sea levels may result in tidal marsh submergence (Moorhead and Brinson 1995) and habitat “migration” as salt marshes transgress landward and replace tidal freshwater and irregularly flooded marsh (R. A. Park et al. 1991).

In an effort to address the potential effects of sea level rise on United States national wildlife refuges, the U. S. Fish and Wildlife Service contracted the application of the SLAMM model for most coastal refuges. This analysis is designed to assist in the production of comprehensive conservation plans (CCPs) for each refuge along with other long-term management plans.

Model Summary

Changes in tidal marsh area and habitat type in response to sea-level rise were modeled using the Sea Level Affecting Marshes Model (SLAMM 6) that accounts for the dominant processes involved in wetland conversion and shoreline modifications during long-term sea level rise (Park et al. 1989; www.warrenpinnacle.com/prof/SLAMM).

Successive versions of the model have been used to estimate the impacts of sea level rise on the coasts of the U.S. (Titus et al. 1991; Lee et al. 1992; Park et al. 1993; Galbraith et al. 2002; National Wildlife Federation & Florida Wildlife Federation 2006; Glick et al. 2007; Craft et al. 2009).

Within SLAMM, there are five primary processes that affect wetland fate under different scenarios of sea-level rise:

- **Inundation:** The rise of water levels and the salt boundary are tracked by reducing elevations of each cell as sea levels rise, thus keeping mean tide level (MTL) constant at zero. The effects on each cell are calculated based on the minimum elevation and slope of that cell.
- **Erosion:** Erosion is triggered based on a threshold of maximum fetch and the proximity of the marsh to estuarine water or open ocean. When these conditions are met, horizontal erosion occurs at a rate based on site- specific data.
- **Overwash:** Barrier islands of under 500 meters width are assumed to undergo overwash during each specified interval for large storms. Beach migration and transport of sediments are calculated.
- **Saturation:** Coastal swamps and fresh marshes can migrate onto adjacent uplands as a response of the fresh water table to rising sea level close to the coast.
- **Accretion:** Sea level rise is offset by sedimentation and vertical accretion using average or site-specific values for each wetland category. Accretion rates may be spatially variable within a given model domain or can be specified to respond to feedbacks such as frequency of flooding.

SLAMM Version 6.0 was developed in 2008/2009 and is based on SLAMM 5. SLAMM 6.0 provides backwards compatibility to SLAMM 5, that is, SLAMM 5 results can be replicated in SLAMM 6. However, SLAMM 6 also provides several optional capabilities.

- **Accretion Feedback Component:** Feedbacks based on wetland elevation, distance to channel, and salinity may be specified. This feedback will be used in USFWS simulations, but only where adequate data exist for parameterization.
- **Salinity Model:** Multiple time-variable freshwater flows may be specified. Salinity is estimated and mapped at MLLW, MHHW, and MTL. Habitat switching may be specified as a function of salinity. This optional sub-model is not utilized in USFWS simulations.
- **Integrated Elevation Analysis:** SLAMM will summarize site-specific categorized elevation ranges for wetlands as derived from LiDAR data or other high-resolution data sets. This functionality is used in USFWS simulations to test the SLAMM conceptual model at each site. The causes of any discrepancies are then tracked down and reported on within the model application report.
- **Flexible Elevation Ranges for land categories:** If site-specific data indicate that wetland elevation ranges are outside of SLAMM defaults, a different range may be specified within the interface. In USFWS simulations, the use of values outside of SLAMM defaults is rarely utilized. If such a change is made, the change and the reason for it are fully documented within the model application reports.
- Many other graphic user interface and memory management improvements are also part of the new version including an updated *Technical Documentation*, and context sensitive help files.

For a thorough accounting of SLAMM model processes and the underlying assumptions and equations, please see the SLAMM 6.0 *Technical Documentation* (Clough et al. 2010). This document is available at <http://warrenpinnacle.com/prof/SLAMM>

All model results are subject to uncertainty due to limitations in input data, incomplete knowledge about factors that control the behavior of the system being modeled, and simplifications of the system (Council for Regulatory Environmental Modeling 2008). Site-specific factors that increase or decrease model uncertainty may be covered in the *Discussion* section of this report.

Sea Level Rise Scenarios

SLAMM 6 was run using scenario A1B from the Special Report on Emissions Scenarios (SRES) – mean and maximum estimates. The A1 family of scenarios assumes that the future world includes rapid economic growth, global population that peaks in mid-century and declines thereafter, and the rapid introduction of new and more efficient technologies. In particular, the A1B scenario assumes that energy sources will be balanced across all sources. Under the A1B scenario, the IPCC WGI Fourth Assessment Report (IPCC 2007) suggests a likely range of 0.21 to 0.48 meters of sea level rise by 2090-2099 “excluding future rapid dynamical changes in ice flow.” The A1B-mean scenario that was run as a part of this project falls near the middle of this estimated range, predicting 0.39 meters of global sea level rise by 2100. A1B-maximum predicts 0.69 meters of global SLR by 2100.

The latest literature (Chen et al. 2006; Monaghan et al. 2006) indicates that the eustatic rise in sea levels is progressing more rapidly than was previously assumed, perhaps due to the dynamic changes in ice flow omitted within the IPCC report's calculations. A recent paper in the journal *Science* (Rahmstorf 2007) suggests that, taking into account possible model error, a feasible range by 2100 of 50 to 140 cm. This work was recently updated and the ranges were increased to 75 to 190 cm (Vermeer and Rahmstorf 2009). Pfeffer et al. (2008) suggests that 2 meters by 2100 is at the upper end of plausible scenarios due to physical limitations on glaciological conditions. A recent US inter-governmental report states "Although no ice-sheet model is currently capable of capturing the glacier speedups in Antarctica or Greenland that have been observed over the last decade, including these processes in models will very likely show that IPCC AR4 projected sea level rises for the end of the 21st century are too low." (Clark 2009). A recent paper by Grinsted et al. (2009) states that "sea level 2090-2099 is projected to be 0.9 to 1.3 m for the A1B scenario..." Grinsted also states that there is a "low probability" that SLR will match the lower IPCC estimates.

To allow for flexibility when interpreting the results, SLAMM was also run assuming 1 meter, 1½ meters, and 2 meters of eustatic sea-level rise by the year 2100. The A1B- maximum scenario was scaled up to produce these bounding scenarios (Figure I.1).

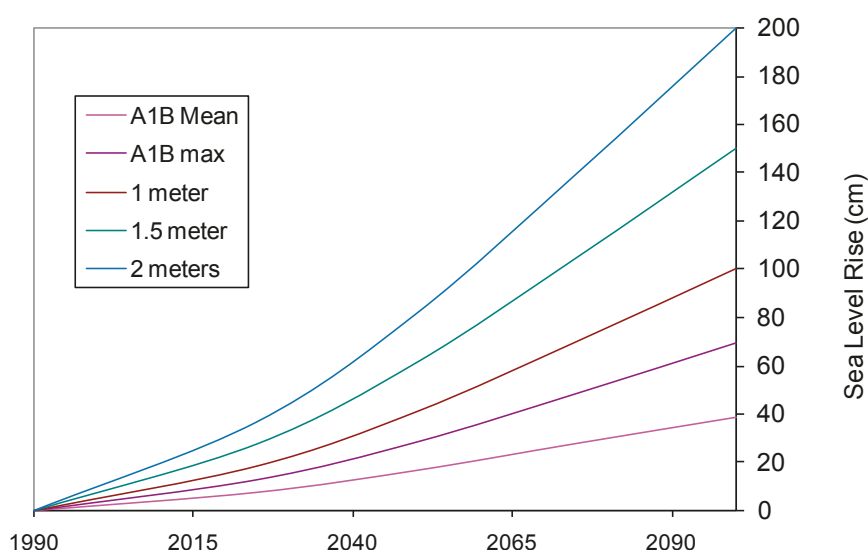
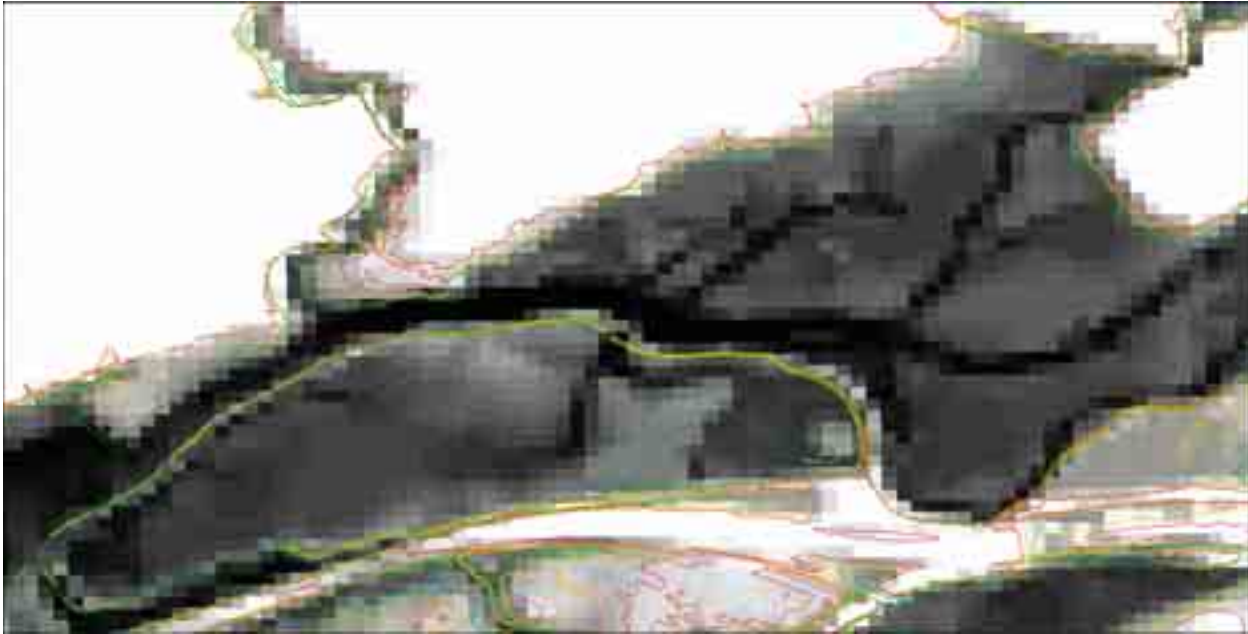


Figure I.1: Summary of SLR scenarios utilized

Methods and Data Sources

The digital elevation map (DEM) used in this model simulation is 2008 LiDAR-derived 2 foot contours originating from the City of Philadelphia Water Department (Figure I.2). A higher vertical resolution LiDAR DEM developed by the Pennsylvania Department of Conservation and Natural Resources for the PAMAP project was not available at the time of writing.

Figure I.2: Contours at 0 feet (green) through 6 feet (red) over DEM of John Heinz NWR.



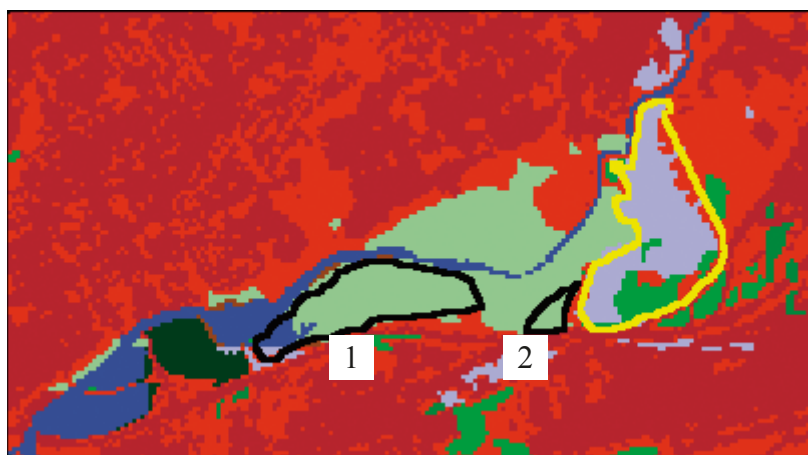
The National Wetlands Inventory (NWI) for John Heinz is based on photo dates of 1989. Several changes were made to the wetland layer based on communication with Brendalee Phillips and Larry Woodward, both from the John Heinz NWR, and Dan Salas, an ecologist from JFNew. Inland fresh marsh in Corps property and Henderson were both changed to tidal fresh marsh based on this communication (Figure I.3).

Converting the NWI survey into 30-meter cells indicates that the approximately 1,200- acre refuge (approved acquisition boundary including water) is composed of the categories as shown below:

	Tidal Fresh Marsh	35.2%
	Undeveloped Dry Land	22.4%
	Inland Open Water	15.5%
	Riverine Tidal	12.1%
	Inland Fresh Marsh	5.6%
	Tidal Swamp	5.2%
	Developed Dry Land	3.5%

There is only one impounded area within John Heinz NWR, that being the freshwater pond at the east of the refuge. Since the previous run, the above-mentioned communication led to the removal of diked status for Henderson and Corps property (Figure I.3).

Figure I.3: Current impoundments (yellow outline) and removed impoundments (black) at Henderson (1) and Corps property (2).



The historic trend for sea level rise was estimated 2.79 mm/year using the nearest NOAA gage (8545240, Philadelphia, PA). The rate of sea level rise for this refuge is somewhat greater than the global average for the last 100 years (approximately 1.7 mm/year).

The tidal range for the John Heinz NWR was specified to vary spatially with two input sites (Figure I.4) using three NOAA tide gages (8542425, Wanamaker Bridge, Darby Creek, PA; 8542699, Norwood, Darby Creek, PA; 8543024, Tinicum 3, Darby Creek, PA) (Figure I.5). Based on these gages, the diurnal range of tide (GT) was estimated at 1.92 meters for the western portion of the refuge and a range of 1.50 meters was utilized in the east.

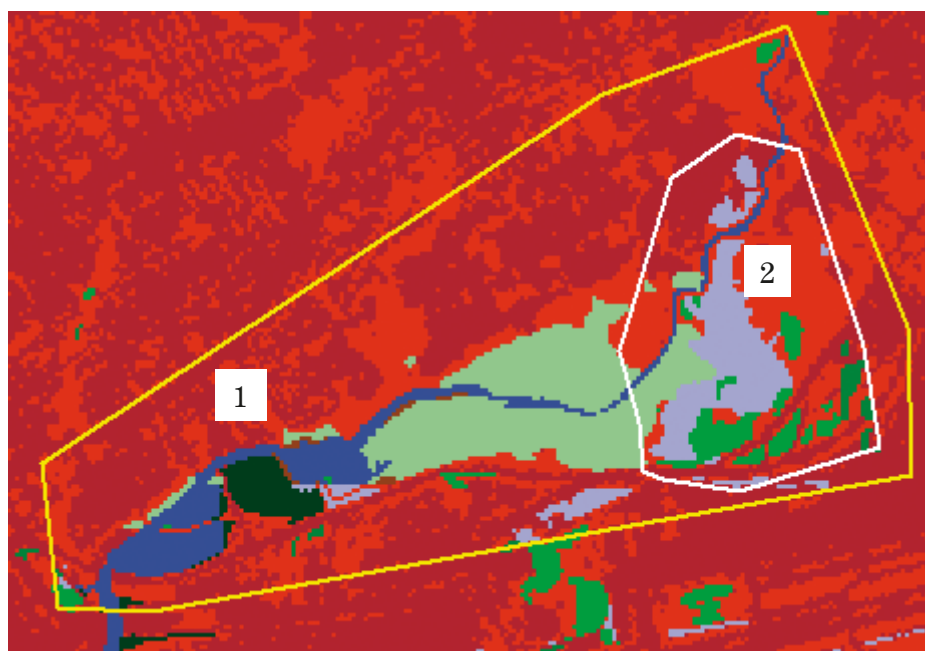


Figure I.4: Input sub-sites.

Figure I.5: NOAA Gage Relevant to the Study Area.



No site-specific marsh accretion data were located for this refuge. The marsh accretion values used were based on a rough average of three different calculations:

- The marsh accretion study located nearest to this study area (Port Mahon DE, Kraft, 1992) measured accretion rates as 4.05 mm/year;
- Based on a large analysis of accretion studies within the mid-Atlantic region (Reed 2008), the average Delaware salt marsh accretion value was calculated at 3.88 mm/yr (n=9);
- Based on data in this same paper (Reed 2008), the average accretion value within Delaware estuaries was calculated at 4.28 mm/yr (n=15)

As these three different calculations are quite similar, accretion rates in regularly flooded marshes were set to 4 mm/year, irregularly flooded marshes to 4 mm/year and tidal fresh were also set to 4 mm/year.

Dan Salas of JFNew indicated that a review of 60-year-old aerial photos indicated that channel erosion was likely lower than 1 foot per year. As a result, marsh erosion was reduced to 1 foot per year (or 0.3048 meters). Swamp and tidal-flat erosion rates for this refuge were set to 2 horizontal meters per year based on long-term measurements of coastal erosion rates in Delaware as presented in Kraft (1992).

Based on site-specific LiDAR-derived elevations, the elevation range for tidal swamp and tidal fresh marsh were altered slightly. Based on an elevation analysis, the minimum elevation for tidal swamp and tidal fresh marsh was set to 0.26 and -0.4 half-tide units respectively. (One half-tide unit is half of the diurnal range of tide or $\frac{1}{2}$ GT.)

The vertical datum used for the available DEM contours is the Philadelphia Vertical Datum (PVD), not NAVD88. Instead of using MTL-NAVD88 for elevation correction values, MTL-PVD was used in this model application. As reported in a paper by Jim Titus, NAVD is 4.63 feet (1.41 meters) lower than PVD (Titus and Strange 2008). The nearest MTL to NAVD correction along the Delaware River was determined to be 0.024 meters, so the MTL-PVD correction used in the model was -1.387 meters $(-1.41 + 0.024)$.

Modeled U.S. Fish and Wildlife Service refuge boundaries for Pennsylvania are based on Approved Acquisition Boundaries as published on the FWS National Wildlife Refuge Data and Metadata web-site. The cell-size used for this analysis was 30 meter by 30 meter cells. Additionally, the SLAMM model will track partial conversion of cells based on elevation and slope.

SUMMARY OF SLAMM INPUT PARAMETERS FOR JOHN HEINZ NWR

Parameter	Global	SubSite 1	SubSite 3
Description		John Heinz	John Heinz 2
NWI Photo Date (YYYY)	1995	1989	1989
DEM Date (YYYY)	1989	2008	2008
Direction Offshore [n,s,e,w]	East	West	West
Historic Trend (mm/yr)	3	2.79	2.79
MTL-NAVD88 (m)	0	-1.387	-1.387
GT Great Diurnal Tide Range (m)	1.65	1.923	1.502
Salt Elev. (m above MTL)	1.45	1.35	1.05
Marsh Erosion (horz. m /yr)	0.3048	0.3048	0.3048
Swamp Erosion (horz. m /yr)	2	2	2
T.Flat Erosion (horz. m /yr)	2	2	2
Reg. Flood Marsh Accr (mm/yr)	4	4	4
Irreg. Flood Marsh Accr (mm/yr)	4	4	4
Tidal Fresh Marsh Accr (mm/yr)	4	4	4
Beach Sed. Rate (mm/yr)	0.5	0.5	0.5
Freq. Overwash (years)	25	25	25
Use Elev Pre-processor [True,False]	TRUE	FALSE	FALSE

Results

John Heinz NWR is predicted to experience some significant effects due to sea-level rise. Refuge tidal fresh marsh – comprising roughly one-third of the refuge – is predicted to be most impacted in SLR scenarios above 0.69 meters. Loss of refuge undeveloped dry land ranges from roughly one quarter to slightly more than one half of its initial acreage.

SLR by 2100 (m)	0.39	0.69	1	1.5	2
Tidal Fresh Marsh	3%	9%	32%	67%	84%
Undeveloped Dry Land	24%	34%	39%	46%	54%
Inland Fresh Marsh	6%	29%	34%	37%	61%
Tidal Swamp	7%	11%	18%	72%	94%
Developed Dry Land	17%	22%	26%	35%	43%
Inland Shore	41%	59%	73%	82%	93%

Predicted Loss Rates of Land Categories by 2100 Given Simulated Scenarios of Eustatic Sea Level Rise

Refined initial-condition elevations and improved dike and habitat maps have resulted in some differences in model simulations as compared to the previous model run. For example, more tidal-fresh marsh loss is predicted across the range of scenarios run than in the previous set of simulations. Dry-land loss rates range from 24% to 54% as opposed to the previous predicted range of 12-64%. There is less inland fresh marsh acreage in the model due to information about the removal of impoundments at the Henderson and Corps properties; unlike the previous model simulations, the remaining inland fresh marsh is predicted to be vulnerable to sea-level rise, with up to 61% predicted lost.

John Heinz NWR

IPCC Scenario A1B-Mean, 0.39 M SLR Eustatic by 2100

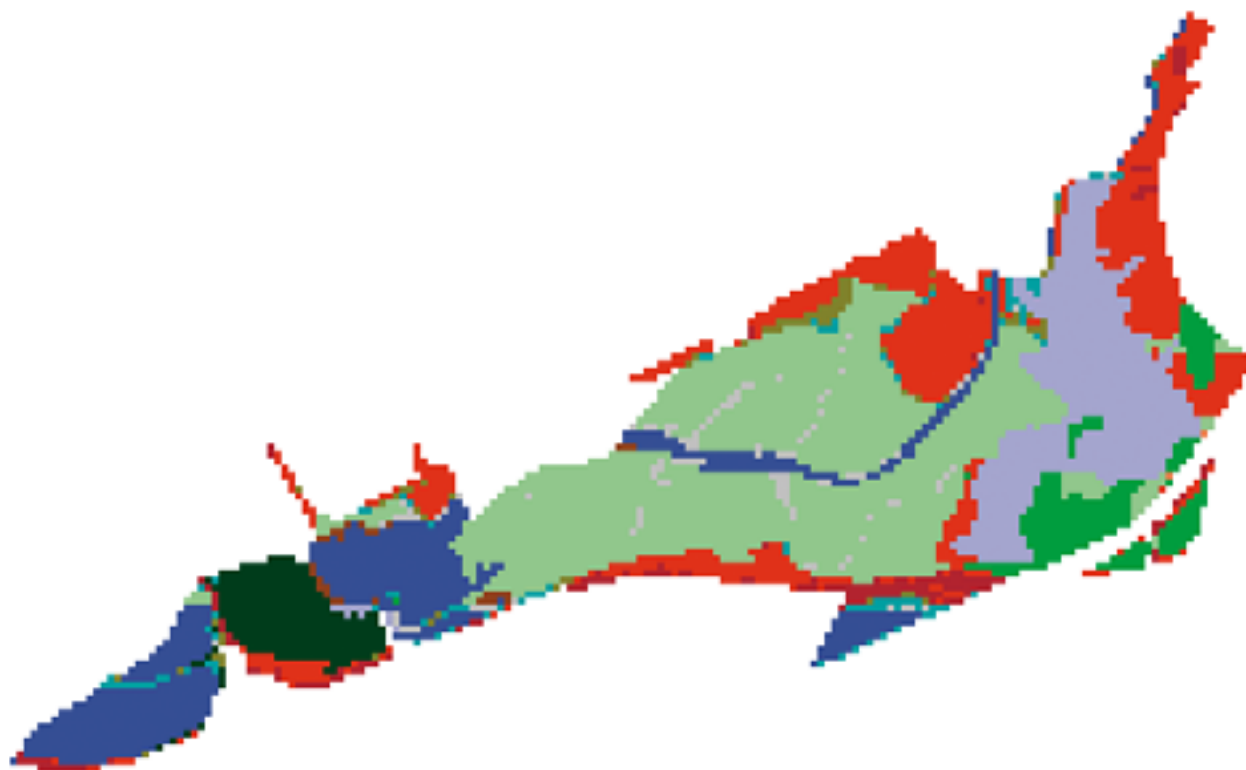
Results in Acres

		Initial	2025	2050	2075	2100
	Tidal Fresh Marsh	419.7	410.1	412.2	409.4	406.3
	Undeveloped Dry Land	268.0	219.0	211.9	206.9	202.5
	Inland Open Water	184.6	164.7	164.5	164.3	164.3
	Riverine Tidal	145.0	68.9	68.1	67.2	63.4
	Inland Fresh Marsh	66.5	62.5	62.5	62.5	62.3
	Tidal Swamp	61.6	58.9	58.6	58.0	57.4
	Developed Dry Land	41.6	36.6	36.1	35.3	34.6
	Inland Shore	7.8	7.0	6.3	5.3	4.6
	Estuarine Open Water	0.0	97.1	102.7	108.9	116.4
	Tidal Flat	0.0	0.0	25.4	22.2	21.1
	Regularly Flooded Marsh	0.0	52.3	24.2	25.5	29.8
	Transitional Salt Marsh	0.0	17.4	21.4	25.5	29.3
	Irregularly Flooded Marsh	0.0	0.2	0.9	3.7	2.8
	Total (incl. water)	1194.7	1194.7	1194.7	1194.7	1194.7

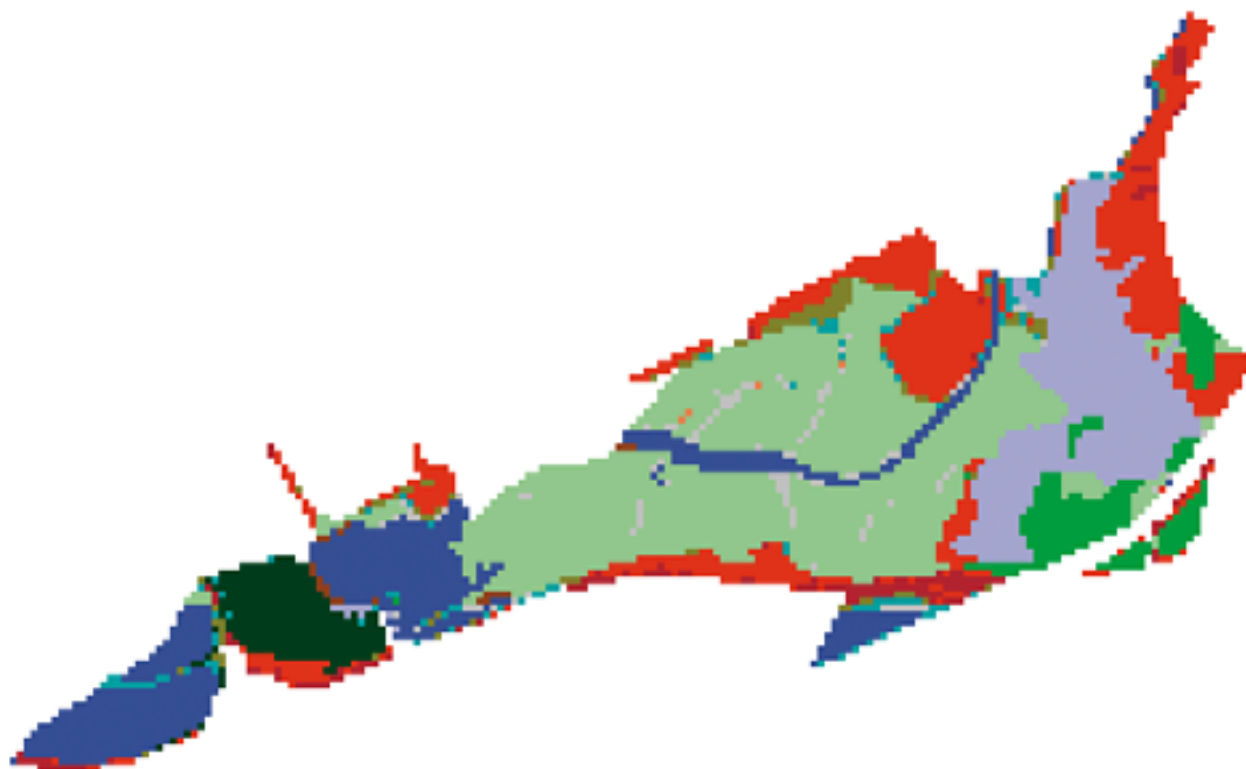
John Heinz NWR, Initial Condition



John Heinz NWR, 2050, Scenario A1B Mean



John Heinz NWR, 2100, Scenario A1B Mean



John Heinz NWR

IPCC Scenario A1B-Max, 0.69 M SLR Eustatic by 2100

Results in Acres

		Initial	2025	2050	2075	2100
	Tidal Fresh Marsh	419.7	406.7	401.2	395.7	381.2
	Undeveloped Dry Land	268.0	217.5	209.8	200.4	176.2
	Inland Open Water	184.6	164.5	164.6	164.4	163.9
	Riverine Tidal	145.0	68.9	67.6	60.7	59.6
	Inland Fresh Marsh	66.5	62.5	62.5	62.3	47.3
	Tidal Swamp	61.6	58.7	58.0	56.6	54.8
	Developed Dry Land	41.6	36.3	35.4	34.2	32.6
	Inland Shore	7.8	6.7	5.5	4.2	3.2
	Estuarine Open Water	0.0	97.6	104.9	123.3	140.2
	Tidal Flat	0.0	0.0	28.6	23.9	20.1
	Regularly Flooded Marsh	0.0	55.2	25.9	33.5	38.1
	Transitional Salt Marsh	0.0	18.1	22.2	26.0	60.0
	Irregularly Flooded Marsh	0.0	1.9	8.6	9.6	17.7
	Total (incl. water)	1194.7	1194.7	1194.7	1194.7	1194.7

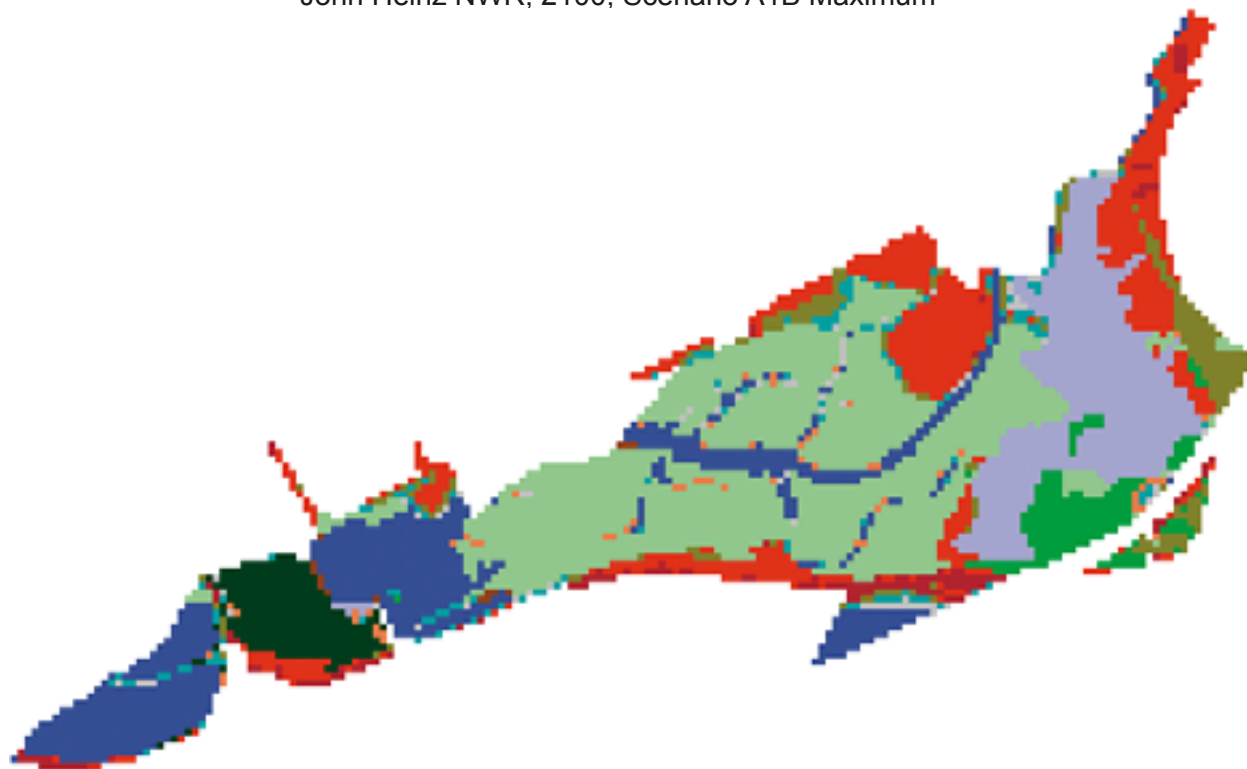
John Heinz NWR, Initial Condition



John Heinz NWR, 2050, Scenario A1B Maximum



John Heinz NWR, 2100, Scenario A1B Maximum



Discussion

In moderate SLR scenarios, only the lowest-elevation areas of the refuge, such as portions of the tidal-fresh marsh bed and water-bordering dry lands, are predicted to be lost to SLR inundation. The pattern of predicted losses within refuge tidal fresh marsh appears to accurately reflect the reality within the refuge as depicted in satellite imagery (Figure I.6).



Figure I.6: Satellite image of central portion of John Heinz NWR.

Opening Henderson and the Corps property to tidal influence increases the predicted risk most significantly to the western portion of Henderson. Notably, the Corps property is predicted to be essentially unchanged by sea level rise even though it is now open to tidal influence due to its high initial-condition elevation. The resilience of the Corps property to inundation carries some uncertainty due to a variety of factors including elevation-data vertical accuracy and predicted marsh accretion rates.

The best-available elevation data for this site were based on a two-foot contour map which means that wetland elevations remain somewhat uncertain. Additionally, site-specific accretion data would provide information about local sediment supplies and how effectively marshes will be able to keep up with accelerated sea level rise. Accretion data were derived based on regional averages.

Bibliography

- Chen, J. L., Wilson, C. R., and Tapley, B. D. (2006). "Satellite Gravity Measurements Confirm Accelerated Melting of Greenland Ice Sheet." *Science*, 1129007.
- Clark, P. U. (2009). *Abrupt Climate Change: Final Report, Synthesis and Assessment Product 3. 4*. DIANE Publishing.
- Clough, J. S., Park, R., and Fuller, R. (2010). "SLAMM 6 beta Technical Documentation."
- Council for Regulatory Environmental Modeling. (2008). *Draft guidance on the development, evaluation, and application of regulatory environmental models*. Draft, Washington, DC.
- Craft, C., Clough, J., Ehman, J., Joye, S., Park, R., Pennings, S., Guo, H., and Machmuller, M. (2009). "Forecasting the effects of accelerated sea-level rise on tidal marsh ecosystem services." *Frontiers in Ecology and the Environment*, 7(2), 73-78.
- Galbraith, H., Jones, R., Park, R., Clough, J., Herrod-Julius, S., Harrington, B., and Page, G. (2002). "Global Climate Change and Sea Level Rise: Potential Losses of Intertidal Habitat for Shorebirds." *Waterbirds*, 25(2), 173.
- Glick, P., Clough, J., and Nunley, B. (2007). *Sea-level Rise and Coastal Habitats in the Pacific Northwest An Analysis for Puget Sound, Southwestern Washington, and Northwestern Oregon*. National Wildlife Federation.
- Grinsted, A., Moore, J. C., and Jevrejeva, S. (2009). "Reconstructing sea level from paleo and projected temperatures 200 to 2100 ad." *Climate Dynamics*, 34(4), 461-472.
- IPCC. (2001). *Climate Change 2001: The Scientific Basis. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge, United Kingdom, 881.
- IPCC. (2007). *Climate change 2007 : the physical science basis*. Cambridge university press, Cambridge.
- Kraft, J.C., Yi, H., Khalequzzaman, M., 1992. Geologic and human factors in the decline of the salt marsh lithosome: the Delaware Estuary and Atlantic Coastal zone. *Sedimentary Geology* 80, 233-246.
- Lee, J. K., Park, R. A., and Mausel, P. W. (1992). *Application of geoprocessing and simulation modeling to estimate impacts of sea level rise on the northeast coast of Florida*.
- Monaghan, A. J., Bromwich, D. H., Fogt, R. L., Wang, S., Mayewski, P. A., Dixon, D. A., Ekaykin, A., Frezzotti, M., Goodwin, I., Isaksson, E., Kaspari, S. D., Morgan, V. I., Oerter, H., Van Ommen, T. D., Van der Veen, C. J., and Wen, J. (2006). "Insignificant Change in Antarctic Snowfall Since the International Geophysical Year." *Science*, 313(5788), 827-831.
- Moorhead, K. K., and Brinson, M. M. (1995). "Response of Wetlands to Rising Sea Level in the Lower Coastal Plain of North Carolina." *Ecological Applications*, 5(1), 261-271.
- National Wildlife Federation, and Florida Wildlife Federation. (2006). *An Unfavorable Tide: Global Warming, Coastal Habitats and Sportfishing in Florida*.
- Park, R. A., Trehan, M., Mausel, P. W., and Howe, R.C. (1989). "The Effects of Sea Level Rise on U.S. Coastal Wetlands." *The Potential Effects of Global Climate Change on the United States: Appendix B - Sea Level Rise*, U.S. Environmental Protection Agency, Washington, DC, 1-1 to 1-55.

- Park, R. A., Lee, J. K., Mausel, P. W., and Howe, R. C. (1991). "Using remote sensing for modeling the impacts of sea level rise.." *World Resources Review*, 3, 184-220.
- Park, R. A., Lee, J. K., and Canning, D. J. (1993). "Potential Effects of Sea-Level Rise on Puget Sound Wetlands." *Geocarto International*, 8(4), 99.
- Pfeffer, W. T., Harper, J. T., and O'Neel, S. (2008). "Kinematic Constraints on Glacier Contributions to 21st-Century Sea-Level Rise." *Science*, 321(5894), 1340-1343.
- Rahmstorf, S. (2007). "A Semi-Empirical Approach to Projecting Future Sea-Level Rise." *Science*, 315(5810), 368-370.
- Titus, J. G., Park, R. A., Leatherman, S. P., Weggel, J. R., Greene, M. S., Mausel, P. W., Brown, S., Gaunt, C., Trehan, M., and Yohe, G. (1991). "Greenhouse effect and sea level rise: the cost of holding back the sea." *Coastal Management*, 19(2), 171-204.
- Titus, J. G., and Strange, E. (Eds.). (2008). "Background Documents Supporting Climate Change Science Program synthesis and Assessment Product 4.1 Coastal Elevations and Sensitivity to Sea-Level Rise.." *EPA 430R07004*, <http://www.epa.gov/climatechange/effects/coastal/background.html>.
- Vermeer, M., and Rahmstorf, S. (2009). "Global sea level linked to global temperature." *Proceedings of the National Academy of Sciences*, 106(51), 21527.

Appendix J

LaVonda Walton/USFWS



Audience inside the refuge's auditorium and large meeting room

Facility Design Plan



Appendix K

Larry Woodward/USFWS



Green heron at impoundment

Summary of Public Comments and Service Responses on the Draft Comprehensive Conservation Plan and Environmental Assessment for John Heinz National Wildlife Refuge at Tinicum

Introduction

In March 2012, the U.S. Fish and Wildlife Service (Service, we, our) completed the John Heinz National Wildlife Refuge at Tinicum (John Heinz NWR, the refuge) Draft Comprehensive Conservation Plan and Environmental Assessment (CCP/EA). That document outlines three alternatives for managing the refuge over the next 15 years and identifies alternative B as the “Service-preferred alternative.” We released the draft CCP/EA for public review and comment from March 22 to April 23, 2012.

We evaluated all the letters, electronic mail, and phone calls we received during that comment period, along with comments recorded during our two public meetings. This document summarizes the substantive comments we received and provides our responses to them. Based on our analysis in the draft CCP/EA and our evaluation of comments, we made minor modifications to alternative B and recommended it to the Northeast Regional Director for implementation. It is that modified alternative B which is detailed in this final CCP. Our modifications include additions, corrections, or clarifications of our preferred management actions. We have also determined that none of those modifications warrants our publishing a revised or amended draft CCP/EA before publishing the CCP.

The changes we made to the final CCP include the following:

- (1) We highlighted that we will work closely with the Philadelphia International Airport to assess any wildlife hazards prior to implementing any wetland restoration under objective 1.1 in Chapter 4, “Management Direction and Implementation.”
- (2) We incorporated updated information provided by the Pennsylvania Fish and Boat Commission into section 3.11 of Chapter 3, “Existing Environment,” and section 2.5 of Appendix C, “Habitat Management Plan.”
- (3) We added the following strategy to objective 2.1 in chapter 4: “Work with partners to identify and obtain resources to replace the water control system in the impoundment.”
- (4) We corrected all format and typographical errors that were brought to our attention throughout the CCP.

As we create the refuge step-down plans, we will take into consideration all comments that relate to those plans.

The Northeast Regional Director (RD) will either select alternative B for implementation, or one of the other two alternatives analyzed in the draft CCP/EA, or a combination of actions from among the three alternatives. The RD will also determine whether a Finding of No Significant Impact is justified prior to finalizing the decision. The RD will make a decision after:

- Reviewing all the comments received on the draft CCP/EA, and our response to those comments.
- Affirming that the CCP actions support the purpose and need for the CCP, the purposes for which the refuge was established, help fulfill the mission of the National Wildlife Refuge System (Refuge System), comply with all legal and policy mandates, and work best toward achieving the refuge’s vision and goals.

Concurrent with release of the approved CCP, we will publish a notice of the availability in the *Federal Register*. That notice completes the planning phase of the CCP process, and we can begin its implementation phase.

Summary of Comments Received

During the comment period, we received 19 sets of responses, both written and oral. We gathered oral comments at the following two public meetings attended by about 17 people: April 10, 2012, 2 to 4 p.m. and 6 to 8 p.m. at the John Heinz National Wildlife Refuge at Tinicum, 8601 Lindbergh Boulevard, Philadelphia, PA 19153.

We received written comments, including electronic mail and post, from 16 organizations and individuals, and we received one phone call with comments. We received letters from the Pennsylvania Fish and Boat Commission, the Pennsylvania Game Commission, the Pennsylvania Department of Conservation and Natural

Resources, the Federal Aviation Administration, and the Philadelphia International Airport, with comments included below. We received a letter from the Pennsylvania Historical and Museum Commission on the draft CCP/EA, and we received comments from members of the Friends of Heinz Refuge.

In the discussions below, we address every substantive comment received during the comment period. Comments were organized by subject. Directly beneath each subject heading, you will see a list of unique letter numbers that correspond to the person, agency, public meeting, or organization that submitted the comment. In some cases, one person may have submitted a comment more than once (public meeting, email, written letter, or telephone). The cross-referenced list appears as attachment 1 to this appendix.

In our responses, we may refer the reader to other places in this document or the draft CCP/EA where we address the same comment. In some instances, we refer to specific text in the draft CCP/EA and indicate how the CCP was changed in response to comments. There are several options for obtaining the full versions of the draft CCP/EA or the final CCP. They are available online at: <http://www.fws.gov/northeast/planning/John%20Heinz/ccphome.html>

For a CD-ROM or a print copy, contact the refuge manager:

Gary M. Stolz
Refuge Manager
John Heinz NWR
8601 Lindbergh Blvd.
Philadelphia, PA 19153
Phone: (215) 365-3118
Email: Gary_Stolz@fws.gov

Service Responses to Comments by Subject

Biological Resources

Biological Resources—General (Letter ID#: 1, 13, 18)

Comment: A commenter asked about the how land changes on the refuge have impacted native versus nonnative species and if we had any information about historic habitat conditions prior to the construction of the impoundment.

Response: Thank you for your interest in refuge habitats. In the last decade, refuge staff has implemented plans to control invasive plants and restore native plants. This past year, the refuge started a volunteer program called Weed Warriors to train volunteers to assist with this endeavor. Historically the impoundment, which was built in the 1600s, was part of a 6,000-acre freshwater tidal marsh. While no official surveys are available from that time, the CCP outlines the possibility of restoring part of the impoundment back to tidal marsh.

Comment: The Pennsylvania Fish and Boat Commission (PFBC) recommended a few corrections to our discussions about species in chapter 2 of the draft CCP.

- Change the name of the red-bellied turtle to eastern redbelly turtle.
- Remove the comment that eastern mud turtles are “now considered potentially extirpated in PA.” There has recently been documentation of the turtles occurring in the State. It was not confirmed in John Heinz NWR but two small populations were discovered elsewhere in Bucks County. PFBC has proposed listing of eastern mud turtle as endangered in the State, which has been approved by agency commissioners and will soon go out for public comment.
- Add the northern snakehead (*Channa argus*) to table 2.6.
- Make the change in table 2.6 that *Gambusia holbrooki* is the synonym of *Gambusia affinis*.
- Use sp. instead of spp. when talking about *Dorsoma* since there is only one species of it in Delaware.

Response: We appreciate your comment and made the suggested corrections to Chapter 2, “Affected Environment,” in the draft CCP, which is now Chapter 3, “Existing Environment,” in the final CCP.

Comment: The Pennsylvania Fish and Boat Commission commented that while crayfishes are not discussed in the section on invertebrates in chapter 2 of the draft CCP, it is possible that crayfish species of conservation interest (*Cambarus diogenes* and *Cambarus acuminatus*) occur within the refuge.

Response: Thank you for your comment. We have added information about these species under the following sections of the final CCP: Section 3.12 “Refuge Biological Resources” in chapter 3 and objective 1.2 in Chapter 4, “Management Direction and Implementation” of the final CCP. We also added this information to the final Habitat Management Plan (appendix C of the final CCP).

Comment: The Philadelphia International Airport and the Federal Aviation Administration requested to be involved early and often in the planning of any refuge activities that may attract any wildlife that could be hazardous to airport activities.

Response: We will continue to work closely with the Philadelphia International Airport and the Federal Aviation Administration. Under objective 1.1 in Chapter 4, “Management Direction and Implementation,” of the final CCP, we have specifically identified that we will work with the Philadelphia International Airport to assess wildlife hazards prior to implementing wetland restoration on the refuge, including potentially restoring portions of the impoundment to tidal marsh.

Habitat Management **(Letter ID#: 5, 9, 17)**

Comment: One person recommended that the refuge be restored to tidal and freshwater marshes and forests in a state as close as possible to its original condition. The commenter stated that this restoration will form a base for sustainable marshes and woodlands that will support a healthy community of organisms.

Response: We agree that restoring refuge lands to historic conditions potentially would be beneficial to native wildlife. However, current refuge habitats, such as the impoundment, may provide important habitat for priority species that might not be available elsewhere in the area due to significant habitat loss around Philadelphia. We plan to study the effects on wildlife and habitat, both positive and negative, of both maintaining the impoundment and restoring the impoundment to tidal marsh. If we determine that restoring a portion of the impoundment to tidal marsh would be beneficial, we would develop comply with the National Environmental Policy Act (NEPA) by preparing another NEPA document and distributing it for public review and comment.

Comment: Audubon Pennsylvania commended the use of adaptive management to maintain and restore native habitats and natural systems of the refuge.

Response: Thank you, we appreciate your support in this effort.

Comment: One commenter expressed support for the continued preservation of habitat for important reptile and amphibian species.

Response: Thank you. We agree this is important and we appreciate your support in this effort.

Invasive Species

(Letter ID#: 9, 13, 17)

Comment: The Pennsylvania Fish and Boat Commission commented that they think it is likely that invasive aquatic crayfishes, which represent a significant threat to the refuge's aquatic systems, occur within the refuge. They stated that management actions, including the removal of dams and other blockages may cause the dispersal of exotic crayfishes, potentially allowing them to invade new areas. The Pennsylvania Fish and Boat Commission recommends that we carefully consider the effect of dam removal on dispersal of exotic crayfishes prior to their removal.

Response: We appreciate your comments. As we look into restoration of a portion of the impoundment to tidal marsh, we will continue to consult with the Pennsylvania Fish and Boat Commission. We have included language in Chapter 4, "Management Direction and Implementation," of the final CCP under objectives 1.2 and 2.1 that acknowledges the potential impacts of nonnative crayfish.

Comment: Audubon Pennsylvania commented that additional emphasis on controlling invasive carp would likely maximize the value of the impoundment habitat for a wide variety of species.

Response: The refuge supports and continues to implement drawdowns of the impoundment to reduce large breeding carp. Restoring part of the impoundment to tidal marsh and mudflats, as described in the CCP, would also aid in the control of the invasive carp.

Comment: One commenter suggested establishing pilot management plots to remove nonnative pest vegetation and establish desirable native plant communities.

Response: We appreciate your suggestion. We agree that controlling nonnative species and restoring native species are important for the refuge. We have recently established a Weed Warrior Program, in which trained volunteers adopt plots, remove invasive plants, and restore the habitat with native plants. The Friends of Heinz Refuge also obtained funding and built a native plant pollinator garden to encourage creation of backyard and schoolyard habitat. Our biology program continues mechanical and chemical control of invasive plants in targeted areas.

Bird Habitat

(Letter ID#: 2, 9)

Comment: Audubon Pennsylvania commented that the restoration of habitat for specific nesting marsh bird populations that have disappeared or diminished from John Heinz NWR deserves more attention, e.g., black-crowned night heron, common gallinule, least bittern, and teal-winged and great egret. They recommend we take the habitat requirements of these marsh-nesting species into consideration in the plan, for instance, that water levels and availability of emergent vegetation are likely key factors in attracting these species back to the refuge.

Response: We appreciate your recommendations for the habitat requirements of marsh-nesting species. We support improving and increasing the habitat for marsh-nesting species. We will continue drawdowns to breakup accumulation of spatterdock biomass. Also, we will continue planting of native emergent vegetation species. Restoring part of the impoundment to tidal marsh and mudflats, as described in the CCP, would also increase habitat for nesting marsh birds.

Comment: Audubon Pennsylvania also stated that they believe it's incorrect that nonnative forest is a nesting site for short-eared owls. Short-eared owls historically nested in the refuge and Philadelphia International Airport area, but there are no records of them nesting during the second Pennsylvania Breeding Bird Atlas (2004 to 2008). Audubon Pennsylvania stated that the poplar forest seems like an unlikely nesting location given the species' habitat preferences.

Response: Thank you for this observation. The reference to short-eared owls nesting in forested habitats on the refuge, or on the refuge in general, was included by mistake. We have removed any reference to short-eared owls nesting on the refuge from the final CCP and the final Habitat Management Plan.

Endangered and Threatened Species

(Letter ID#: 13)

Comment: The Pennsylvania Fish and Boat Commission commended our emphasis on protecting and restoring habitats for State-listed species, such as the redbelly turtle and southern leopard frog.

Response: Thank you, we appreciate your support in this effort.

Impoundment Management and Restoration

(Letter ID#: 1, 2, 9, 11, 12, 16, 17)

Comment: One person asked about the effect that the conversion of the impoundment to tidal marsh would have on species diversity.

Response: At this time, we do not know what effect the conversion of the impoundment to tidal marsh would have on species diversity. As part of the planning process for the impoundment restoration project, we intend to conduct studies to determine whether it would be desirable, in terms of wildlife habitat, and logistically feasible to restore a portion of the impoundment to tidal marsh.

Comment: A commenter asked what the timeline is for an impoundment restoration study.

Response: It will take most of the life of the 15-year CCP to conduct the impoundment restoration study, perhaps more. We will need to conduct several species and habitat assessments to see if it would be desirable to restore the impoundment from a wildlife and habitat perspective. If desirable from a wildlife and habitat perspective, we will also work with the town of Tinicum and Philadelphia International Airport to determine how restoring a portion of the impoundment would impact them. Lastly, we will need to make sure that it is logistically feasible to restore the impoundment and that the funding is available to do so.

Comment: The Philadelphia International Airport and the Federal Aviation Administration expressed concern that creation or enhancement of freshwater tidal marsh would create an attractant for hazardous wildlife within the critical area of wildlife separation for the Philadelphia International Airport. As such, the airport does not fully support alternatives B and C because they propose creating freshwater marsh in the refuge. With planning and precautions, alternative C could be more desirable to the airport than B because converting the impoundment to freshwater tidal marsh will lessen the attractant value to migrating waterfowl and the delayed restoration in alternative C would allow time for the Philadelphia International Airport to work with the refuge to assess potential wildlife hazards prior to any habitat modification. Both alternatives B and C, however, are preferable to alternative A (current management) because the current impoundment is a significant attractant to migrating waterfowl; converting the impoundment to freshwater tidal marsh would lessen the attractant value.

Response: We understand the concerns of the Philadelphia International Airport and the Federal Aviation Administration and will continue to work closely with them on projects that might create attractants for wildlife, particularly migratory birds. We have highlighted our intent to work closely with them by including specific strategies in chapter 4 of the final CCP, under objectives 1.1 and 2.1.

Comment: Audubon Pennsylvania commented that restoring a portion of the impoundment to tidal marsh and improving the remaining impoundment to allow for management of water levels is a responsible approach to management of migrant shorebirds, migrant waterfowl, and nesting marsh birds. This approach would give the refuge manager more flexibility and the ability to predictably provide habitat for migrant birds at the appropriate times of year.

Response: Thank you, we appreciate your support in this effort.

Comment: A few commenters said that they would like to see the refuge take a more aggressive approach to managing the impoundment for migrating shorebirds and breeding marsh birds such as Virginia rail, American bittern, and common gallinule. One commenter wanted to know about the interim options to improve shorebird habitat in the spring and fall prior to tidal restoration in the impoundment. Another suggested partnering with local birding and conservation organizations to get funding necessary for better managing the water level in the impoundment.

Response: We appreciate the interest in migrating shorebirds and breeding marsh birds. These are important species for the refuge. As discussed in chapter 2 of the draft CCP/EA, and chapter 3 of the final CCP, it is currently difficult for the refuge to manage water levels in the impoundment for a variety of reasons. For example, there is uncontrolled runoff into the impoundment during rain events and Darby Creek, which receives impoundment waters, is currently higher than the impoundment itself. This makes it difficult for refuge staff to manage water levels in the impoundment for these species or other species. It will take many years to determine if or how we should restore portions of the impoundment to tidal marsh. In the interim, we are continuing to seek additional funding sources and partnerships to replace the water control system in the impoundment. If successful, this should improve our ability to manage the impoundment for these and other species. We inadvertently left this out of the draft CCP/EA. We have added this strategy to chapter 4 of the final CCP, under objective 2.1. In the long-term, if we restore part of the impoundment to tidal marsh and mudflats after appropriate hydrology studies are completed, as described in the CCP, it would also aid in the control water level management issues.

Deer Management **(Letter ID#: 1, 2, 9)**

Comment: A commenter asked how we are planning on reducing deer at the refuge.

Response: Overabundance of deer is a problem on the refuge, as discussed in Chapter 3, “Existing Environment,” and under objective 1.2 in Chapter 4, “Management Direction and Implementation,” of the final CCP. As discussed in chapter 4, objective 1.2 of the final CCP, we are planning to hire wildlife control specialists to reduce the deer population. Additional detail was available in the Draft Deer Management Plan, which was posted on the refuge planning Web site. The Deer Management Plan has been finalized in conjunction with the CCP and is posted on the refuge’s planning Web site.

Comment: One commenter wondered how deer control on the refuge would compare to deer control at Valley Forge.

Response: Deer control on the refuge is similar to deer control at Valley Forge National Historic Park. Similar to Valley Forge National Historic Park, the refuge will use wildlife control specialists to reduce and maintain the deer population.

Comment: A couple of commenters strongly supported the development and implementation of a deer management plan. One person expressed concern that if a deer management plan is not implemented as soon as possible, there won’t be a native environment to save. Audubon Pennsylvania commented that an overabundance of deer has a profound impact on forest structure and regeneration and is an issue that must be addressed to secure the future of forested habitats.

Response: We agree overabundance is a problem, as discussed in as discussed in Chapter 3, “Existing Environment,” and under objective 1.2 in Chapter 4, “Management Direction and Implementation,” of the final CCP. The Deer Management Plan, which has been finalized in conjunction with the final CCP, describes the actions we plan to take to reduce the deer population.

Comment: One person recommended establishing and studying long-term deer exclosures on the refuge.

Response: We agree that establishing deer exclosures on the refuge is valuable. We have already established small comparative plots and studies to collect information used in developing the Deer Management Plan. We will continue to maintain and study these areas, and will use the information collected to implement our Deer Management Plan. Several other long-term exclosures have been installed to start native trees and shrubs, although the fencing needs to be replaced or repaired. After the visitor services step-down plan is complete, refuge staff will also consider installing interpretive signs for visitors to learn about deer, native plants, and exclosures.

Comment: Audubon Pennsylvania commended the Service for focusing on habitat impacts caused by deer instead of setting a desired density goal. They said the refuge will need detailed planning to determine the most effective and efficient methods for bringing the deer herd into balance with the available habitat at the refuge.

Response: Thank you, we agree with your comment. The Deer Management Plan will help us to do this.

Public Use and Access

General Public Use—(Letter ID #: 1, 2, 7, 14, 16, 17)

Comment: One person commented that some parts of the refuge are far to walk to and suggested using golf carts to transport visitors.

Response: We appreciate your comment and recognize that it may be difficult for some visitors to walk the entire refuge. We have allowed bicycle access on the refuge to address this issue. However, maintaining and storing golf carts would be logistically difficult, would divert staff time and refuge funding from implementing wildlife and habitat projects and priority public uses, and would likely increase disturbance of wildlife and habitats. For these reasons we do not intend to provide golf carts for visitors.

Comment: One commenter asked for more details on how the refuge works with senior citizens and suggested that we reach out to this demographic more for help with refuge projects and volunteering.

Response: Thanks for your suggestion on working more closely with senior citizens. We recognize that senior citizens have a lot to contribute to the refuge. Refuge staff encourages senior citizen volunteers and visitors. We currently work with the Retired Senior Volunteer Program (RSVP) and the Senior Environmental Corps for water testing. We will continue to look into new partnerships that could potentially reach more of the demographic. We welcome any assistance or recommendations in how we can engage this audience more effectively.

Comment: One commenter expressed concern about the impact that making the impoundment smaller would have on public use, stating that local people who hike and walk their dogs, who aren't birding, probably come to walk by the water in the spring.

Response: We recognize that people value the impoundment both aesthetically and for wildlife viewing opportunities; however, it also provides valuable habitat for migratory birds and other species of conservation concern. The Refuge System has a wildlife-first mission, and Service policy prioritizes maintaining biological integrity, diversity, and environmental health of refuges. We will be conducting studies to understand how restoring part of impoundment will affect refuge biological integrity, diversity, and environmental health. The findings of this study will ultimately inform our decision whether or not to restore the impoundment to tidal marsh. Even if we restore part of the impoundment to tidal marsh, we anticipate that there would still be some impoundment left.

We do not yet know how marsh restoration would affect wildlife and habitat. However, one of the establishing purposes of the refuge is to protect Tinicum Marsh and freshwater tidal marsh, and to provide environmental education opportunities about the marsh. Restoring the marsh would facilitate the establishing purposes and bring marsh habitat closer to the visitor center, making it easier to conduct environmental education programs that focus on the marsh.

Comment: The Friends of Heinz Refuge (FOHR) commended inclusion of noise issues into the CCP as it affects both visitors and wildlife. They recommended that the Service gather as much noise-level data as possible and work with Pennsylvania Department of Transportation to develop a system of noise barriers along the I-95/refuge boundary.

Response: We appreciate FOHR's support on this issue. As specified in chapter 4, under goal 1, we plan to work with Pennsylvania Department of Transportation and Philadelphia International Airport to evaluate effects of traffic and airport noise on refuge wildlife to determine if a sound barrier is warranted. If warranted, we will determine location(s), design(s), and types(s) of appropriate barriers. In the interim we will encourage tree planting along transportation corridors to help buffer the noise.

Comment: A couple of commenters suggested increasing refuge visibility and presence in the western side of refuge, particularly by developing and distributing interpretive and trail signs throughout the area, developing and offering programs specific to the location at least once a month, constructing a small visitor contact station on the site, and offering refuge literature as part of the planned kiosk.

Response: We will be updating or replacing the existing kiosk and signs on the western side of the refuge. However, at this time, even if proposed increases in staffing and budget were implemented, building and staffing a satellite visitor contact station would not be feasible. We appreciate the recommendations for additional programs and outreach materials. We will consider them as we develop our visitor services step-down plan.

Comment: One commenter recommended providing a dog droppings bag dispenser near the three-panel kiosk, on the parking lot side, so it is visible to people who walk their dogs on the refuge. The commenter said that many people do not enter the visitor center so do not see or notice the existing dog droppings bag dispenser.

Response: Thank you for your comment. We will discuss placement of dog droppings bag dispenser in this location and will make appropriate changes if needed. Visitor service facilities will be further evaluated and improved through the visitor services step-down plan.

Comment: One person proposed improving trail access to the wetland restoration area and access to tidal mudflats along the creek.

Response: We agree that improving trail access is important. In the CCP, we include constructing a boardwalk into the tidal marsh (see map 4.2 of the final CCP) that would allow improved access while protecting sensitive resources. Darby Creek trail also has been rebuilt providing improved access to view the tidal mudflats. The restored trail is now open with a bench and view deck. The wetland restoration area also has a view deck. Additional improvements and trail access will be considered in the visitor services step-down plan.

Wildlife Observation (Letter ID #: 1, 17)

Comment: A commenter recommended having bird observation by the Morton House with binoculars and signage to alert visitors to the bird observation opportunity.

Response: Thank you for your comment. The Morton House is outside of refuge boundaries and jurisdiction. It is on the property of Norwood Township. Refuge staff will evaluate visitor service facilities such as binoculars and signage in the future visitor services step-down plan.

Comment: One person suggested establishing effective bird blinds to allow wildlife observation without disturbing the wildlife.

Response: Thank you for your comment. We agree that wildlife blinds are important tools that improve wildlife observation opportunities and decrease disturbance to wildlife. A new photography blind was added by the little boardwalk and two new view decks are designed into the new tidal marsh boardwalk (see map 4.2 of the final CCP). Refuge staff will evaluate visitor service facilities such as bird blinds as we develop the visitor services step-down plan.

Public Use Conflicts (Letter ID: 1, 2, 16)

Comment: Several commenters expressed concern about increasing conflicts between refuge users—particularly between visitors who come for walking and wildlife observation and the visitors who bike. Two commenters said that safety is an issue for walkers and wildlife observers, and traditional users, such as birders, get “run over” by bicyclists.

Response: We recognize that there can be conflicts between different refuge user groups. One of the reasons we have allowed bicycling on the refuge is to encourage more environmentally friendly ways for visitors to access the refuge instead of using motorized transportation. Managing multiple and sometimes conflicting uses on the refuge is often difficult. We have tried to address these conflicts in our Compatibility Determinations by creating stipulations to minimize conflicts. For example, we have limited bicycling to the main trails that are more equipped to handle more diverse uses. Furthermore, we are working to improve the enforcement of the stipulations, such as improving visibility of refuge signs and increasing outreach efforts to educate users about authorized public uses and locations. We encourage visitors to notify us if there are violations or ongoing conflicts and we will take them into consideration and revise the Compatibility Determinations, if needed. We are required to reevaluate non-priority public uses every 10 years, but will do it sooner if necessary.

Comment: A few commenters said that the refuge is like a city park to some visitors. One commenter observed that visitors may have a limited idea about allowed uses at the refuge and another commenter suggested limiting the number of visitors to maintain “refuge-ness.”

Response: We are committed to protecting wildlife and habitat and providing quality, wildlife-dependent recreation opportunities for visitors. We agree there is a balance between the number of visitors and types of public uses allowed and providing opportunities for quality, wildlife-oriented public use. Maintaining this balance can be a challenge. Because of its proximity to Philadelphia, many visitors to the refuge are more familiar with local parks, and the use of those spaces, than with the National Wildlife Refuge System. However, one of the refuge’s establishing purposes is to provide opportunities for environmental education. In addition, the National Wildlife Refuge System Administration Act of 1996, as amended by the National Wildlife Refuge System Improvement Act of 1997 (P.L. 105-57; 111 Stat. 1253) requires us to facilitate opportunities for priority public uses where compatible. This, combined with its location, puts the refuge in a rare position to be an ambassador for the National Wildlife Refuge System and to share important conservation messages with diverse audiences. Reaching out to nontraditional audiences also supports many Service and Refuge System initiatives including the urban refuge initiative outlined in the Refuge System vision document. We believe, with proper oversight, refuge resources can accommodate the levels of public use described in the final CCP. We will continue to evaluate effects of public use on refuge wildlife and habitat as well as conflicts between public uses and will adjust activities as warranted.

Comment: Several commenters said that dogs are a problem on the refuge because there are some people who remove their dogs from the leash and do not pick up after their dogs. One commenter wants infractions to be documented, quantified, and posted to the public. If the infractions continue, the commenter said that dog walking should be disallowed at the refuge.

Response: We recognize that there are conflicts between user groups. While dog walking is not a priority public use, it is a traditional use on the refuge and many people participate in priority public uses while walking their dogs, such as environmental interpretation. We have tried to address these conflicts in our Compatibility Determinations by creating stipulations to minimize conflicts. For example, we have limited dog walking to the main trails that are more equipped to handle more diverse uses. Furthermore, we are working to improve the enforcement of the stipulations, such as improving visibility of refuge signs and increasing outreach efforts to educate users about authorized public uses and locations. Refuge Law Enforcement keeps written logs of warnings and tickets and we encourage visitors to call the visitor center if there are violations or ongoing conflicts. We will take them into consideration and revise the Compatibility Determinations, if needed. We are required to reevaluate non-priority public uses every 10 years, but will do it sooner if necessary. Refuge staff will evaluate visitor service facilities such as regulation signs when we develop the visitor services step-down plan.

Marsh Boardwalk
(Letter ID: 2, 16)

Comment: A couple of commenters proposed creating a new boardwalk to the marsh.

Response: We agree and have proposed constructing a boardwalk into the marsh under objective 4.1 in Chapter 4, “Management Direction and Implementation,” of the final CCP.

Comment: A comment was made that the money allocated to build a new boardwalk out into the marshland should instead be allocated to upgrading the water control system. The commenter said that in more than 10 years, they have not seen anyone use the old bird blind that was formerly overlooking the marsh restoration area and that the proposed location of the boardwalk is farther than the average visitor will walk. They suggested building other infrastructure projects closer to the regularly trafficked areas.

Response: At this time, while we recognize that the boardwalk may be far for some people to walk, it would be difficult to construct a boardwalk closer to the major refuge facilities. The boardwalk will be built where there is tidal habitat and will be sited based on environmental concerns and conditions. One of the refuge’s establishing purposes is educating the public about Tinicum Marsh. The boardwalk will facilitate our ability to support this purpose. Once built, we will design environmental education programs to take advantage of the boardwalk. We recognize that controlling water levels in the impoundment is an issue. Please see our response to the last comment under “Impoundment Management and Restoration” above.

Refuge Signs
(Letter ID: 2, 16)

Comment: One commenter suggested putting better signs at the State Route 420 end of the refuge.

Response: Thank you for your comment, we agree and are in the process of developing better signs that should be put up this year.

Comment: One commenter recommended using the three-paneled kiosk near the entrance to the Dike and Haul Roads in a more dynamic way to educate and inform visitors. She said that we should make the information posted at the kiosk more interesting and timely with flyers about upcoming events, “bird/animal of the month” posters, etc. She also suggested moving the trail maps and activity brochures to the parking lot side of the kiosk since they are not visible to people who come directly from the parking lots.

Response: We appreciate your comments. These will be helpful for us to consider as we develop the visitor services step-down plan. We hope to complete this plan within 3 years of finalizing the CCP.

Comment: A couple of commenters suggested that the refuge post more signs for key locations, such as “Fisherman’s Pier,” “Observation Platform,” “Hoy’s Pond,” etc., including all the roads and trails. One person also suggested putting distance markers along all the roads and trails. All of this signage would provide visitors with points of reference for, for instance, describing the location of a wildlife sighting. Similarly, it was proposed that the refuge post a large, readable map of the trails at the refuge with all the key locations identified.

Response: We appreciate your comments. They will be important for us to take them into consideration as we develop the visitor services step-down plan. We hope to complete this plan within 3 years of finalizing the CCP.

Comment: One commenter suggested putting up signs to clearly notify visitors about prohibited and allowed uses on the refuge. In particular, she recommended putting up a sign saying “No Littering” since littering has been a consistent problem on the refuge, and posting a sign that outlines the rules for bicycling on the refuge.

Response: Thank you for your comment. Refuge staff have begun to put up regulation signs on trails within the refuge. Refuge staff will evaluate visitor service facilities such as interpretive and regulatory signs when we develop the visitor services step-down plan.

Environmental Education (Letter ID #: 6, 9, 14)

Comment: Audubon Pennsylvania, the Wyncote Audubon Society, and FOHR all expressed support for the proposed environmental education programs. The Wyncote Audubon Society said that they support “the continued growth and development of educational and environmental programs at the Heinz NWR to build on the ongoing successful array of visitor services, improvements in trails, signage, as well as habitat management, deer control, and educational programs that have occurred since the opening of the Cusano Environmental Education Center.” Audubon commented that connecting urban youths to nature is a critical piece of meeting the refuge mission and that the refuge is an ideal place to introduce children to nature.

Response: Thank you, we appreciate your support on this issue and look forward to partnering with Audubon Pennsylvania, the Wyncote Audubon Society, FOHR and others to connect urban youth with nature.

Comment: The FOHR noted that there has been historic resistance by most local school districts to become involved with education opportunities offered at the refuge.

Response: The refuge has established strong relationships with some local schools and we hope to partner with new schools and school districts to expand our environmental education program. The environmental education component of the visitor services step-down plan will help us address this.

Comment: The FOHR also commented that they agree that making better school and refuge connections is important and offered a few suggestions for how the refuge could do that:

- Using citizen science programs as a means to track climate change parameters, excite visitors and students, and improve refuge visibility.
- Offering non-teacher-led field trips to make the refuge more competitive amongst its peers – docent training should be a high priority.
- Reactivating the Refuge Environmental Education Development (REED) team or creating a new one.

Response: We appreciate your comments. They will be important for us to take into consideration as we develop the visitor services step-down plan. We hope to complete this plan within 3 years of finalizing the CCP. We have proposed increasing refuge staff- and volunteer-led environmental education programs and will be involving partners in developing new programs and evaluating old ones. This may include reactivating the REED team or creating a similar team.

Comment: The FOHR also wanted clarity in the CCP about the intended source of funding for busing students to the refuge. Currently FOHR provides funds for busing inner-city students to the refuge—will this continue to be FOHR’s responsibility or will the Service start funding it?

Response: We appreciate FOHR’s support for refuge activities, including providing funding for busing students to refuge. Current refuge funding does not include sufficient funding for busing students to the refuge. We will work with FOHR and other partners to find ways to meet these needs, and hope that FOHR will continue to provide funding for busing students when needed. It is possible that sufficient funding from FOHR may not always be available, particularly as we plan to expand the refuge’s environmental education programs. We have modified language in chapter 4, goal 3, under “Strategies that apply to all objectives” to indicate we will work with FOHR to continue funding and pursue alternative funding or grant programs if needed for supporting transportation to and from the refuge.

Refuge Advertising and Visibility

(Letter ID#: 1, 2)

Comment: A few commenters said that there is a need to increase public knowledge about the refuge and its purposes. One person suggested using the Comcast public access service to help advertise the refuge. Two commenters recommended increasing signage advertising the refuge in the surrounding area, including increasing and improving signage on I-95 and near the airport. One commenter suggested adding “visitor center” onto signs to draw people to the refuge.

Response: We appreciate your comments. They will be important for us to take into consideration as we develop the visitor services step-down plan. We hope to complete this plan within 3 years of finalizing the CCP.

Comment: One commenter suggested expanding the refuge’s Web-based information and asked what that would entail.

Response: Yes we are planning to expand the refuge’s Web-based information as discussed under objectives 3.2 and 4.1 in Chapter 4, “Management Direction and Implementation,” of the final CCP. Expanding the refuge’s Web-based information will involve developing additional programs and materials, finalizing the visitor services step-down plan, and working with partners to coordinate and cross-post information as appropriate. Some of the additional content will be fairly easy to develop and post. However, we are planning to develop programs specific to target audiences. This is a new approach to refuge environmental education and interpretation and will require more time and resources.

Hunting and Fishing

(Letter ID#: 1, 7)

Comment: A commenter asked if fishing is compatible at the refuge.

Response: Recreational fishing is an historic, priority public use on the refuge. It is allowed in the refuge, as per the Compatibility Determination in appendix B of the final CCP.

Comment: One person wanted to know what the process and timeline is to get a deer hunt established.

Response: Opening a refuge to hunting is a lengthy process. Prior to opening any refuge to hunting, the Service must complete several steps. First, we must meet the requirements of NEPA including involving the public and preparing the appropriate NEPA document (an environmental assessment or environmental impact statement) to evaluate a reasonable range of alternatives and the associated effects on the human environment. Next, we must prepare the NEPA decision document which documents the alternative (or combination of alternatives) we are choosing to implement. As part of this process, we must complete an evaluation of effects on federally listed species under section 7 of the ESA. We must also prepare a news release, an outreach plan, a hunt plan, a compatibility determination, and any refuge-specific regulations. Once finalized and signed by the Regional Director, necessary documents are submitted to the Service’s Headquarter’s office in Washington D.C. These documents must be submitted on or before January 31 to open for the following fall. Once initiated, this entire process would likely take about 2 years.

Comment: Several commenters were supportive of opening the refuge to hunting. A couple of commenters suggested opening a small, controlled deer hunt to help with deer management. One person suggested an early morning hunt from dawn to early morning. Another commenter proposed using sharpshooters to reduce deer numbers then using a hunt to maintain deer population.

Response: As specified in chapter 4, objective 5.2 of the final CCP, we will work with the Pennsylvania Game Commission to explore the possibility of opening a portion of the refuge to limited deer hunting in the future. However, these hunts are not expected to be adequate to control the deer population and could not be implemented quickly or easily. We plan to wait for the Folcroft Landfill remediation to be completed before we consider opening the refuge to hunting. This would help minimize conflict between hunting and other priority public uses, such as environmental education and interpretation.

Climate Change

Climate Change (Letter ID#: 1, 10)

Comment: A commenter wanted to know how we are addressing climate change.

Response: Currently, the refuge is implementing several monitoring programs to help us better address climate change. We will also be taking climate change into account for current, planned, and future restoration efforts. We discuss the specifics of this in section 3.4 of Chapter 3, “Existing Environment,” in the final CCP.

Comment: The Defenders of Wildlife wanted us to consider their factsheet on climate change and national wildlife refuge conservation planning as we finalize the CCP.

Response: We consider climate change to be an important issue in developing and implementing CCPs and refuge step-down plans and we are required to consider it in our planning efforts as per Executive Order 13514. We appreciate this information.

Refuge Partnerships and Volunteers

Partnerships (Letter ID#: 1, 14)

Comment: One commenter asked how we are interfacing with the Darby Creek Valley Association and the airport expansion.

Response: The refuge continues to maintain and enhance working relationships with local conservation associations and adjacent and nearby landowners. The airport expansion is occurring outside the scope of the CCP; however, the refuge continues to take an active interest in projects that are occurring in the area, including the proposed airport expansion. Refuge staff, PHL and FAA work together to review and comment on the appropriate NEPA documents for projects on the refuge and airport.

Comment: One commenter recommended that we consider including key partners (at minimum, FOHR representatives) in the development of phase two visitor services plans. They said that including representatives from the FOHR will help them to determine the additional resources they need to develop in order to be ready to assist the refuge with plan implementation.

Response: We value the contributions of FOHR members and our other partners. As we state under goal 3 in Chapter 4, “Management Direction and Implementation,” of the final CCP, we will work with partners to develop new environmental education and interpretation programs and to evaluate current programs. We appreciate the willingness of FOHR to assist us in this effort.

Comment: FOHR commented that a few FOHR contributions were not recorded in the draft CCP, including the Groundhog Day Family Festival, the Nature Walk programs led by FOHR volunteers, the FOHR funding of busing for student field trips to the refuge, and the FOHR facilitation of the partnerships with Pennsylvania Horticultural Society and Longstreth Elementary School in Philadelphia.

Response: Thank you for providing this information. We will update our files. There are so many programs occurring on the refuge that it is difficult for us to capture all of them in the CCP.

Comment: FOHR strongly supports a more formal volunteer program. They suggested that priority funding opportunities be given to the refuge to fill the position of volunteer coordinator to facilitate environmental education.

Response: We appreciate your comment and the support of FOHR. We agree that a more formal volunteer program is important. While the volunteer coordinator is not currently our highest priority to fill, we will consider ways to strengthen the volunteer program with current staff during the development of the visitor services step-down plan.

Refuge Administration

Facilities (Letter ID#: 4, 19)

Comment: One person requested putting a portable toilet at the end of the impoundment trail away from the visitor center.

Response: Currently, there are two portable toilets along the impoundment trail, one at the parking lot and one at the observation tower. Portable toilets from the west end of the refuge (Route 420 entrance) were removed after years of vandalism. Refuge staff will evaluate visitor service facilities such as portable toilets when we develop the visitor services step-down plan. Installing additional portable toilets will depend on available staffing and budgets.

Comment: Pennsylvania Historical and Museum Commission (PHMC) commented that future activities at the refuge that involve new construction or ground disturbing activity should be reviewed with their office on a project by project basis to assess potential effects on cultural resources.

Response: We concur. We will continue to work with PHMC to meet our obligations under Section 106 of the NHPA, as well as other applicable laws and regulations. This is stipulated in chapter 3, section 3.3.7 of the draft CCP/EA and chapter 4, section 4.2.7 of the final CCP.

Alternatives

Alternative B (Letter ID#: 2, 9, 15, 16)

Comment: A commenter wanted to know why there is a higher education component in alternative C but not in alternative B.

Response: Both alternatives B and C in the draft CCP included working with colleges and universities. However, under alternative B, we would focus more resources toward working with kindergarten through 12 grade students, while under alternative C we would put more resources toward working with colleges and universities. The intent is to set priorities to help us focus limited resources.

Comment: A few commenters, including Audubon Pennsylvania and the Pennsylvania Department of the Conservation of Natural Resources, expressed support for alternative B. The letter from Audubon Pennsylvania said that “Audubon supports the Service’s preferred alternative B, and hopes that funding levels for the National Wildlife Refuge System and John Heinz NWR in particular, will be sufficient over the next fifteen years to allow alternative B to be fully implemented.” The letter from the Pennsylvania Department of the Conservation of Natural Resources said that “PA DCNR supports alternative B because it provides the best opportunity to increase the population of State-listed plants and increase acreage of State rare natural communities such as freshwater tidal marsh and coastal plan forest.”

Response: Thank you for your comments, we appreciate the support of Audubon Pennsylvania, the Pennsylvania Department of the Conservation of Natural Resources, and others for our preferred alternative.

Alternative C (Letter ID#: 9)

Comment: Audubon Pennsylvania noted that alternative C calls for delayed restoration of the entire impoundment to tidal marsh in light of imminent sea level rise in the coming decades. However, they suggest that it may be most responsible to keep portions of the current impoundment separated from tidal flow and allow for human management of water levels so that some shorebird and waterfowl habitat can be assured every year.

Response: We appreciate your comments and we agree that there may be value in maintaining some of the impoundment. At this time, it is unclear what the relative benefits are to restoring some or all of the impoundment. We will be studying the potential environmental impacts of restoring the impoundment, including completing additional NEPA compliance, before we implement any restoration plans.

Planning Process and Policy

CCP Process (Letter ID#: 3)

Comment: One commenter requested that we send postcards to area residents letting them know when public meetings are going to take place. She suggested that direct contact may reach more people.

Response: We made significant efforts to ensure that area residents were aware of the CCP planning process. We distributed press releases to local media, posted the public meeting information on the refuge Web site, and sent copies of newsletters to contacts on our mailing list. We are aware that several articles were also printed in local papers. The large quantity of area residents around the refuge makes it difficult for us to do mailings to all of them. However, we agree that we should add the mailing addresses for all refuge-adjacent landowners to our contact list, and we will do so for the final CCP and for future refuge activities.

Attachment 1-Letter ID Numbers and Respondents

Letter ID Number	Name or Public Meeting Date and Time
1	April 10, 2012 2 p.m. to 4 p.m. meeting
2	April 10, 2012 6 p.m. to 8 p.m. meeting
3	Jeannette Guess
4	Anonymous
5	Donna Wilhelm
6	Jane Henderson - Wyncote Audubon Society
7	Lois L. Brooks - Friends of Heinz Refuge
8	Mary Morrison - National Park Service
9	Brian J. Byrnes – Audubon Pennsylvania
10	Julie Kates – Defenders of Wildlife
11	Keith Brune – Philadelphia International Airport
12	Evelyn Martinez – Federal Aviation Administration
13	Christopher A. Urban – PA Fish and Boat Commission
14	Jean R. Diehl – Friends of Heinz Refuge
15	Frederick Sechler – PA Department of Conservation and Natural Resources
16	Debbie Beer
17	Stephen Kacir
18	Phone call with Philadelphia International Airport and Federal Aviation Administration
19	Pennsylvania Historical and Museum Commission

Appendix L



Ron Holmes/USFWS

Deer and egrets

Finding of No Significant Impact

John Heinz National Wildlife Refuge at Tinicum Comprehensive Conservation Plan

In March 2012, the U.S. Fish and Wildlife Service (Service) published the John Heinz National Wildlife Refuge (NWR) at Tinicum Draft Comprehensive Conservation Plan and Environmental Assessment (CCP/EA). John Heinz NWR was established in 1972 to preserve and restore the natural area known as Tinicum Marsh, to promote environmental education, and to afford visitors an opportunity to study wildlife in its natural habitat. The total approved acquisition boundary encompasses 1,200 acres near the Delaware River in Pennsylvania. Currently, John Heinz NWR includes 993 acres of freshwater tidal marsh, open water, grassland, and forest habitats. It is an important migratory stopover for birds along the Atlantic Flyway, and provides habitat for State-listed threatened and endangered species such as the eastern redbelly turtle. The John Heinz NWR Draft CCP/EA outlines three alternatives for managing the refuge over the next 15 years. It carefully considers their direct, indirect, and cumulative impacts on the environment and their potential contribution to the mission of the National Wildlife Refuge System (Refuge System). The draft CCP/EA restates the refuge's purposes, creates a vision for the next 15 years, and proposes six goals to be achieved through plan implementation. Alternative B is identified as the Service-preferred alternative. Chapter 3 in the draft CCP/EA details the respective goals, objectives, and strategies for each of the three alternatives. Chapter 4 of the draft CCP/EA describes the consequences of implementing those actions under each alternative. The draft plan's appendixes provide additional information supporting the assessment and specific proposals in alternative B. A brief overview of each alternative follows:

Alternative A (Current Management): The Council on Environmental Quality regulations on implementing the National Environmental Policy Act (NEPA) require a “no action” alternative, which we define as “continuing current management.” This alternative describes our existing management priorities and activities, and serves as a baseline for comparing and contrasting alternatives B and C. It would maintain our present levels of approved refuge staffing and current biological and visitor programs. We would continue to focus on providing native tidal marsh habitat for migrating and nesting wading birds; wintering marshbirds, waterfowl, and shorebirds; and other wildlife. We would also continue to actively control invasive species, manage grassland habitats, and maintain dikes and water levels in the impoundment. Our environmental education program would continue to focus on providing training for teachers so they could guide field trips on refuge property.

Alternative B (Service-preferred Alternative): This alternative combines the actions we believe would most effectively achieve refuge purposes, vision, and goals, and respond to public issues. Under alternative B, we would expand our freshwater tidal marsh restoration efforts, implement additional forest habitat restoration and management efforts, and increase monitoring efforts for species and for climate change effects. Our environmental education program would focus on expanding staff-led and volunteer-led programs for urban youth. We would also develop environmental education programs that focus on this audience, and work to develop long-term relationships with schools and school districts. We would work to expand environmental interpretation opportunities and infrastructure on the refuge as well.

Alternative C (Delayed Restoration and Focus on Regional Role of Refuge): Alternative C would focus on restoring degraded forests and converting specific grassland areas to shrubland habitat. As in alternative B, we would emphasize invasive species management, freshwater tidal marsh restoration, and monitoring for climate change adaptation. However, under alternative C, we would delay much of these efforts to more fully assess the potential effects of climate change. We would also explore restoring all of the impoundment to tidal marsh. Under alternative C, environmental educational programming would concentrate on providing high school and college-level programs focused on encouraging and training the next generation of conservation professionals and environmentally concerned citizens. We would also focus on playing a more regional role in conservation efforts.

We distributed the draft CCP/EA for a 30-day period of public review and comment from March 22 to April 23, 2012. We received 17 letters, calls, or emails representing individuals, organizations, and State agencies and had approximately 17 people attend two public meetings held on April 10, 2012. Appendix K in the final CCP includes a summary of those comments and our responses to them.

After reviewing the proposed management actions, and considering all substantive public comments and our responses to them, we have determined that the analysis in the EA is sufficient to support our findings. We are selecting alternative B, as presented in the draft CCP/EA with the following changes recommended by the planning team, to implement as the final CCP. Changes we made in the final CCP include the following:

- We highlighted that we will be working closely with the Philadelphia International Airport to assess any wildlife hazards prior to implementing any wetland restoration under objective 1.1 in chapter 4.
- We incorporated updated information on species provided by the Pennsylvania Fish and Boat Commission into section 3.3 of chapter 3 and section 2.5 of appendix C.
- We added the following strategy to objective 2.1 in chapter 4: “Work with partners to identify and obtain resources to replace the water control system in the impoundment.”
- We corrected all format and typographical errors that were brought to our attention.

We conclude that alternative B, with the above changes, in comparison to the other two alternatives will: (1) best fulfill the mission of the Refuge System; (2) best achieve the refuge’s purpose, vision, and goals; (3) best maintain and, where appropriate, restore the refuge’s ecological integrity; (4) best address the major issues identified during the planning process; and (5) be most consistent with the principles of sound fish and wildlife management. Specifically, in comparison to the other two alternatives, alternative B provides the biggest increase in the diversity, integrity, and health of high quality habitats through enhanced habitat management. It also provides the most reasonable and effective improvements to existing public use programs that are in demand, with minimal impacts to wildlife and habitats. The plans to increase staffing and improve and expand infrastructure are reasonable, feasible, and will result in the most efficient management of the refuge and best serve the American public. This Finding of No Significant Impact (FONSI) includes the EA by reference.

We have reviewed the predicted beneficial and adverse impacts with alternative B that are presented in chapter 4 of the draft CCP/EA, and compared them to the other alternatives. We specifically reviewed the context and intensity of those predicted impacts over the short- and long-term, and considered the cumulative effects. The review of each of the NEPA factors to assess whether there will be significant environmental effects is summarized here (40 C.F.R. 1508.27).

(1) Beneficial and adverse effects—We expect the final CCP (alternative B) management actions to benefit both the wildlife and habitats at John Heinz NWR. Important examples include the measures to reduce deer browse damage to trees and shrubs, control nonnative invasive species, maintain and restore important native tidal marsh to provide foraging habitat for colonial-breeding wading birds at Pea Patch Island, and manage a variety of other habitats on the refuge to benefit breeding and migrating songbirds, waterfowl, and raptors, as well as amphibians, reptiles, and mammals of conservation concern. Except for potentially restoring some of the impoundment to tidal marsh, benefits will not result from any major change in management strategy; rather, they will be incremental to the effects of the current management. As stated in the draft CCP/EA, we will complete additional NEPA compliance before implementing any restoration of the impoundment. Therefore, we do not anticipate any significant beneficial or adverse effect on the human environment.

(2) Public health and safety—We expect the good safety record of the refuge to continue based on the protective actions provided in the stipulations of the compatibility determination for each of the authorized public uses on the refuge. There should be no significant impact on public health and safety from the implementation of the CCP.

(3) Unique characteristics of the area—The primary, unique characteristic of John Heinz NWR is its freshwater tidal marsh in proximity to urban Philadelphia. We expect the preservation and restoration measures in the CCP, such as increased control of nonnative invasive species, to benefit these wetlands for which the refuge was created, and to benefit the surrounding habitats. As in (1), the benefits will be incremental to the effects of the ongoing management measures originally instituted to protect these resources. Thus, we do not expect these incremental benefits to result in a significant impact on the human environment.

(4) Highly controversial effects—The management actions in the final CCP such as invasive species control, habitat restoration, deer control, and wildlife-dependent recreational uses are time-tested measures. Their effects on the refuge are widely known from past management and monitoring. There is no scientific controversy over what these effects will be. Thus, there is little risk of any unexpectedly significant effects on the environment.

(5) Highly uncertain effects or unknown risks—The management actions in the final CCP are evolutionary. They are mostly refinements of the existing management measures that we have used for many years. We will implement a comprehensive monitoring program to reassess the effectiveness of each planned improvement. With the data available on the current management results and the system in place to adjust for any unplanned effect, we do not find a high degree of uncertainty or unknown risk that the CCP will cause any significant impact on the environment.

(6) Precedent for future actions with significant effects—The purpose of the CCP is to establish the precedent for managing the refuge for up to 15 years. The effects of that management are designed as gradual improvements over the existing conditions, not global changes. For example, strategies such as expanding environmental education and improving tidal marsh will be completed over several years. Therefore, we do not expect this precedent to cause any significant impact on the environment.

(7) Cumulatively significant impacts—The CCP provides the programmatic, long-term management plan for the refuge. We plan to coordinate with surrounding land managers to promote common goals such as managing wildlife, habitat, and public use to minimize potential conflicts. Our management jurisdiction is limited, however, to the refuge lands, and we do not foresee any of the coordinated activities rising to the level of a significant effect on the environment. Within the term of the CCP, we intend to pursue additional projects such as constructing a boardwalk, additional trails, and expanding the refuge administrative offices. We will examine the cumulative effects of all projects under the CCP before they are approved, and we will conduct whatever level of additional NEPA review is warranted.

(8) Effects on scientific, cultural, or historical resources—Evaluation of archaeological resources presented in the draft CCP/EA showed no significant impacts on these resources from the planned management activities. Service archaeologists in the Northeast Regional Office keep an inventory of known sites and structures, and ensure that we consider them in planning new ground-disturbing or structure-altering changes to the refuge. Throughout the implementation of the CCP, we will continue to consult with the Pennsylvania Historical and Museum Commission on any ground disturbing activities (e.g., expanding administrative offices) and other projects that might affect cultural resources.

(9) Effects on Endangered Species Act (ESA)-listed species and habitats—As detailed in the CCP, we have contacted the Service's Pennsylvania Ecological Services Field Office under Section 7 of the ESA. No ESA-listed species are expected to occur on the refuge. The CCP also protects the delisted bald eagle. Our management actions are designed to preserve and improve the existing habitat for this species and there is no ESA-designated, critical habitat on the refuge. The American eel is currently being evaluated to see if it warrants listing as a candidate species under the ESA. We will consult with appropriate Ecological Services staff on American eel or other species if warranted. Therefore, we do not anticipate any significant effects on these ESA resources.

(10) Threat of violating any environmental law—Our habitat management actions are designed to benefit the environment. They will comply with all applicable protections such as the Clean Water Act and the Clean Air Act. Pursuant to the National Wildlife Refuge System Administration Act (16 U.S.C. 668dd(e)(3), 668dd(m)). Our public fishing program under the CCP requires all participants to

Finding of No Significant Impact

comply with State regulations. We do not anticipate a threat that the CCP will violate any environmental law or cause any significant impact on the environment.

Based on this review, we find that implementing alternative B will not have a significant impact on the quality of the human environment, in accordance with Section 102(2)(c) of NEPA. Therefore, we have concluded that an Environmental Impact Statement is not required, and this FONSI is appropriate and warranted.



ACTING
Wendy Weber
Regional Director
U.S. Fish and Wildlife Service
Hadley, Massachusetts

27 Aug 2012

Date

U.S. Fish & Wildlife Service
John Heinz National Wildlife Refuge at Tinicum
8601 Lindbergh Blvd.
Philadelphia, PA 19153
215/365 3118
Gary_Stolz@fws.gov
<http://www.fws.gov/heinz/index.html>

Federal Relay Service
for the deaf and hard-of-hearing
1 800/877 8339

U.S. Fish & Wildlife Service
<http://www.fws.gov>

For Refuge Information
1 800/344 WILD

August 2012

